SUPREME COURT, U. S.

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IN THE

Supreme Court of the United States

October Term, 1970

No. 407

DECCA LIMITED,

Petitioner,

v.

THE UNITED STATES,

Respondent.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF CLAIMS

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The Petitioner, Decca Limited, a British corporation, respectfully prays that a Writ of Certiorari issue to review the judgment and opinion of the United States Court of Claims entered in this proceeding on January 23, 1970.

Opinions Below

The opinion of the Court of Claims appears in the Appendix hereto, at pages 79-141. The opinion of the Trial Commissioner, Donald E. Lane, filed on January 23, 1969 appears in the Appendix at pages 45-78. In addition, the order of the Court of Claims dated April 17, 1970 denying petitioner's timely motion for rehearing appears in the Appendix at pages 142-143.

Statutory Provisions and Rules Involved

Rule 147(b), Rules of the United States Court of Claims

(b) Commissioner's Report: The court may adopt the commissioner's report, including conclusions of fact and law, or may modify it, or reject it in whole or in part, or direct the commissioner to receive further evidence, or refer the case back to him with instructions. Due regard shall be given to the circumstance that the commissioner had the opportunity to evaluate the credibility of the witnesses; and the findings of fact made by the commissioner shall be presumed to be correct.

Rule 52a, Federal Rules of Civil Procedure

Rule 52.

FINDINGS BY THE COURT

(a) Effect. In all actions tried upon the facts without a jury or with an advisory jury, the court shall find the facts specially and state separately its conclusions of law thereon, and judgment shall be entered pursuant to Rule 58; and in granting or refusing interlocutory injunctions the court shall similarly set forth the findings of fact and conclusions of law which constitute the grounds of its action. Requests for findings are not necessary for purposes of review. Findings of fact shall not be set aside unless clearly erroneous, and due regard shall be given to the opportunity of the trial court to judge of the credibility of the witness. The findings of a master, to the extent that the court adopts them, shall be considered as the findings of the court. If an opinion or memorandum of decision is filed, it will be sufficient if the findings of fact and conclusions of law appear therein. Findings of fact and conclusions of law are unnecessary on decisions of motions under Rules 12 or 56 or any other motion except as provided in Rule 41(b).

35 USC § 103

§ 103. Conditions for patentability; non-obvious subject matter

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Jurisdiction

The judgment of the Court of Claims was rendered on January 23, 1970. A timely motion for rehearing was denied on April 17, 1970, and this Petition for Certiorari was filed within 90 days of that date. This Court's jurisdiction is invoked under 28 USC § 1255(1).

Questions Presented

(1) What is the standard of appellate review of findings of fact of the Court of Claims?

(2) If the "substantial evidence" rule applies, did the evidentiary or primary findings of the Court of Claims adequately support the ultimate findings, and did the Court of Claims fail to make findings of fact as to material issues?

(3) If the "clearly erroneous" rule applies, were the ultimate findings of the Court of Claims clearly erroneous?

(4) What is the nature of the presumption of correctness of the Trial Commissioner's findings of fact, and what

is the standard of evidence needed to overcome that presumption?

(5) Are the issues of comparative inoperability and non-equivalence of the prior art to the patent in suit, and the non-suggestiveness for combination of the prior art references, material to the non-obviousness test under § 103 of the Patent Laws?

Statement of the Case

Petitioner is the owner of United States Letters Patent No. 2,578,980 (referred to as the '980 patent). The '980 patent relates to a type of navigation system known as "LORAN" and more particularly to a modern version which has gone into world-wide use under the name of "Loran-C".

Petitioner sued the United States in the United States Court of Claims for infringement of the '980 patent basing jurisdiction on 28 USC § 1498, and 35 USC § 281. Other patents not involved in this petition also were in issue.

The Trial Commissioner, Donald E. Lane, found the '980 patent valid and infringed. As to the identity between Loran-C and the patent in suit he found that:

> "Defendant's 'Loran-C' navigation system is substantially identical in structure, mode of operation, and result to the structure defined in claims 1, 2, and 3 of the '980 patent in suit." (p. 42, lines 8-10)

With respect to the practicality of the patent in suit, the Commissioner found that:

> "Plaintiff has clearly shown that the combinations defined in claims 1, 2, and 3 of its '980 patent have been incorporated into a commercial Loran-C system and used. Thus, the evidence warrants the conclusion that the '980 patent is not a paper patent." (p. 46, lines 19-22)

With respect to validity, defendant contended that claims 1-3, of the '980 were obvious in view of a combination of selected portions of the following prior art references:

Runge, U. S. Patent No. 202880, January 28, 1936.

LF-Loran

O'Brien, British Patent No. 579170, April 13, 1942.

A device known in radio as a "sucked-in" oscillator.

The Commissioner made various evidentiary and primary findings as follows:

(A) *Evidentiary and Primary Findings Relating to Non-obviousness.*

(1) That the LF-Loran and '980 arrangements for maintaining the radio transmissions in synchronism "are different and are not equivalents" (p. 36, lines 24-25);

(2) That LF-Loran operates "in a manner substantially different" from '980 (p. 41, lines 19-20),

(3) That the British O'Brien patent contained no suggestion as to how it could be used in a pulse system (such as the '980 and Loran-C systems) (p. 37, lines 27-31; p. 40, lines 23-29),

(4) That Runge was concerned only with a continuous wave system (p. 38, lines 19-20 and p. 41, lines 1-3) and would not be operative in the context of a pulse system (such as '980 and Loran-C) (p. 38, lines 21-25),

(5) That Runge did not suggest the solution of the '980 problem (p. 38, lines 31-32), and

(6) That

> "Without the benefit of hindsight obtained from the '980 patent, there is no instruction or suggestion in the prior art of the manner in which the phase discriminator and phase regulator of the British patent might be incorporated into the LF Loran system in order to achieve synchronism between the carrier signals radiated from separate transmitting stations." (p. 40, lines 23-29)

(B) *Ultimate Finding of Non-obviousness.*

Based on these evidentiary and primary findings the Commissioner then made the following ultimate finding:

> "It is concluded that the invention set forth in claims 1, 2, and 3 of the '980 patent would not have been obvious in 1946 to a person of ordinary skill in the art." (p. 41, lines 3-6).

* * *

At the hearing before the Court of Claims and in the briefs, petitioner conceded, as it had done before the Commissioner, that selected portions of the said prior art references could be assembled to meet claims 1-3 of '980; but petitioner contended, as the Commissioner found, that the comparative inoperativeness and non-equivalence of the LF-Loran and Runge systems, and the non-suggestiveness for combination of the other references, showed that combining them as of 1946 had not been obvious. The Court of Claims, however, took a different approach. It quoted and relied on what is described as the "colorful and useful guideline to be employed in Section 103 cases" set forth by Judge Rich of the U. S. Court of Customs and Patent Appeals in the case of, *Application of Winslow*, 365 F2d 1017-20 (CCPA 1966) in which the inventor is depicted as sitting in his study with the prior art references attached

to the walls around him. Judge Rich's test, however, presupposes the preliminary steps of selection and juxtaposition and does not require the Court to make any preliminary evaluation as to the non-equivalence, comparative inoperativeness, and non-suggestiveness for combination of the prior art; and therefore, by following Judge Rich's test, the Court of Claims simply deleted the above outlined evidentiary and primary findings of the Commissioner. Instead, findings of a much less specific nature were made. For example, at page 105, lines 5-7, the Court of Claims found that:

> "The would-be inventor knows, of course, of modulators which can turn pulses into continuous waves and back again".[1]

And again at page 105, lines 12-15 the Court of Claims found that:

> "The general idea of pulse synchronization, the use of master and slave stations for pulse transmittals, the use of the oscillator to lock master signal to that of slave, would all be borrowed from the known art."[2]

Then, without reverting to the Trial Commissioner's evidentiary and primary findings, the Court of Claims proceeded directly to an ultimate finding of obviousness.

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[1] The lack of evidentiary support for this statement is significant. Certainly none of the four references cited by the Court of Claims shows how this can be done in the context of Loran-C or '980. If specific references had been available to show this they should have been cited so that their relevance could have been analyzed.

[2] If specific support had been cited for this statement, the weakness of the statement would have been disclosed. The statement actually refers to Loran-A techniques which were used in LF-Loran and which the Trial Commissioner found to be non-equivalent to '980 and to operate "in a manner substantially different" from '980.

Reasons for Granting the Writ

(1) The standard of appellate review of findings of fact of the Court of Claims and of the Trial Commissioner needs to be clarified and the case at bar places the issue before the Court.

The basic problem is whether the "substantial evidence" rule (28 USC (1946 Ed.) § 288) or the "clearly erroneous rule (Federal Rule 52(a)) applies. Certiorari is needed because the Supreme Court has not yet ruled on this issue and it is important both to litigants and to the Court of Claims to resolve the substantial ambiguity which exists. The case at bar illustrates the need for clarification and places the issue before the Court.

Historically, the Supreme Court was not empowered to review findings of fact of the Court of Claims; *Chesapeake and Potomac Telephone Co. v. U.S.*; 281 US 385 (1930). In 1939, however, this limitation was removed and review by the Court according to the "substantial evidence" rule was authorized to correct errors of the Court of Claims assigned to the following:

(a) "lack of evidence to sustain a finding of facts."

(b) "that an ultimate finding or findings are not sustained by findings of evidentiary or primary facts," or

(c) "that there is a failure to make a finding of fact on a material issue."

(53 Stat. 752, 28 USC (1946 Ed.) § 288)

Subsequently, in 1948, the above quoted passage was removed "as unnecessary", according to the reviser's note; 28 USCA § 1255 (1966 Ed.) p. 138. Ambiguity arose, however, out of the effect of the removal of the above quoted passage. Did it leave the standard of review as it was, *i.e.*

the "substantial evidence" standard, or did it bring in the "clearly erroneous" standard of Rule 52(a) of the Federal Rules of Civil Procedure with respect to findings of the Court of Claims? Arguments can be made either way; see *Stern and Gressman, Supreme Court Practice*, 73-75 (4th Ed. 1969).

A preliminary question, however, having to do with Court of Claims Rule 147(b), may need to be resolved. In the case at bar the Court of Claims ignored the Trial Commissioner's evidentiary and primary findings and set aside his ultimate findings. The preliminary problem is that Court of Claims Rule 147(b) states that "due regard shall be given to the circumstance that the trial commissioner had the opportunity to evaluate the credibility of the witnesses; and the findings of fact of the commissioner shall be presumed to be correct." Thus, the preliminary question is whether the facts at bar justify a holding that the presumption of Rule 147(b) had been overcome. Obviously, some latitude is permissible for the Court of Claims to interpret its own rules, but at some point a failure to follow a rule of court upon which litigants rely in the preparation of cases, becomes such a departure "from the accepted and usual course of judicial proceedings" as to call for an exercise of the Supreme Court's supervisory power. The case at bar could be such a case. Here the Commissioner's evidentiary and primary findings were obviously relevant, and they amply supported the Commissioner's ultimate finding. Under such circumstances, it would seem that the Court of Claims should at least make specific rulings setting aside the evidentiary and primary findings of the Commissioner before rejecting his ultimate finding. Otherwise we do not see how the presumption of Rule 147(b) can have any force or meaning.

In the case at bar no such preliminary rulings were made. This could amount to reversible error by itself.

If, however, a lenient standard is to be applied to Court of Claims Rule 147(b), and a reversal is not deemed appropriate for reason of departure from the usual course of judicial proceedings, then a decision will be necessary as to the standard of appellate review to be applied to findings of fact of the Court of Claims.

If the above quoted scope of review established by the 1939 act is controlling, then either a reversal or a remand will be warranted. The Court of Claims did not assess (a) the nonequivalence of the prior art to the patent in suit, (b) the comparative inoperativeness of the prior art compared to the patent in suit, or (c) the non-suggestiveness of the prior art leading to the combination. These were material issues bearing on the non-obviousness test under Section § 103 of the Patent Laws. *Graham* v. *John Deere Co.*, 383 U.S. 1, 26 (1966); *United States* v. *Adams*, 383 U.S. 39, 51 (1966). In addition, substantial evidence supported the Commissioner's evidentiary and primary findings on those issues. Accordingly the Court of Claims' decision fails under the "substantial evidence" rule because it reached its ultimate findings without proper evidentiary and primary findings and also without making findings as to material issues.

If, however, the 1948 revision of Title 28 USC is held to bring the appellate review of findings of fact of the Court of Claims within the "clearly erroneous" standard of Federal Rule 52(a), the next question is whether to treat the Commissioner or the Court of Claims as the Trial Court. Federal Rule 52(a) states that "due regard shall be given to the opportunity of the trial court to judge the

credibility of witnesses". If Federal Rule 52(a) is applicable, these words would seem to require the Court of Claims not to set aside the findings of the Commissioner unless the Commissioner's findings are "clearly erroneous" because under the presently established procedure, the Commissioner is the only one who has the opportunity to evaluate the credibility of the witnesses. By this interpretation, a reversal of the decision below would follow because the Commissioner's findings were not clearly erroneous, they were not even ruled to be clearly erroneous, and accordingly, they should not have been set aside. On the other hand, if Rule 52(a) is held to apply only to the findings of Court of Claims itself and not to the findings of the Commissioner, at least "due regard shall be given" to the Commissioner's findings, and since the Court of Claims does not evaluate witnesses, the "clearly erroneous standard should not be applied to those findings of the Court of Claims which differ from those of the Commissioner. Thus, even under this latter interpretation, a reversal of the decision below can follow.

(2) Certiorari should also be granted because the decision below is in conflict with the recent decisions of *Graham* v. *John Deere Co.*, 383 US 1 (1966), and *United States* v. *Adams*, 383 US 39 (1966), with respect to the tests for non-obviousness under Section 103 of the Patent Laws.

In the *Graham* case the key fact on which the case turned was the finding that there was no "operative mechanical distinction" between the prior art and the patent in suit (p. 26). The *Adams* case turned on the finding that there was "no equivalency" between the Adams battery and the prior art (p. 51), also that the Adams battery had different "operating characteristics" (p. 51). In addition, in the *Adams* case emphasis was placed on the nonsuggestiveness

of the prior art leading to the patented combination (p. 51). Thus, it is perfectly clear that nonequivalence, comparative inoperativeness, and nonsuggestiveness of combination are important, material facts in the obviousness test under Section 103.

In the case at bar, the Trial Commissioner made evidentiary and primary findings of fact on the issues of nonequivalence, comparative inoperability, and nonsuggestiveness of the prior art to the patent in suit, in accordance with the tests of the *Graham* and *Adams* cases. The Court of Claims, however, set aside these primary findings of the Trial Commissioner and reached an ultimate conclusion of obviousness without again addressing itself to these same primary issues. The obviousness test employed by the Court of Claims was taken from an opinion by Judge Rich of the United States Court of Customs and Patent Appeals, *In re Winslow* (*supra*), a portion of which the Court of Claims quoted adding its own emphasis as follows (p. 104):

> "'We think the proper way to apply the 103 obviousness test to a case like this is to first picture the inventor as working in his shop with the prior art references—*which he is presumed to know*—hanging on the walls around him—Section 103 requires us to presume full knowledge by the inventor of the prior art in the field of his endeavor.'"

Such a test is clearly not the same as the tests of the *Graham* and *Adams* cases. While it has long been the law that the inventor is charged with knowledge of the prior art (see *Mast, Foos & Co. v. Stover Mfg. Co.*, 177 US 485, 493 (1900), to picture the inventor as surrounded by a particular small group of cited references rather than by the thousands of possible references, presupposes the steps of *selection* and *juxtaposition* of that group of references.

Neither of these steps may be obvious, and each may actually involve invention by virtue of suggesting a combination not otherwise obvious.

Moreover, important collateral factors may affect the decisions to select and juxtapose references. For instance, the decisions to select and juxtapose would clearly be influenced by the inoperativeness of the references, their functional nonequivalence in the context of the patent in suit, and whether they contain any suggestiveness for combination. Of course, with the aid of hindsight and the patent in suit, selection and juxtaposition of the correct prior art references becomes an easy task. Therefore we regard the above quoted standard of Judge Rich as incomplete and somewhat misleading. In any event, the Supreme Court has made it clear that the test to be used to determine obviousness includes the above-cited collateral factors which the Court of Claims did not include.

Accordingly, by refusing to adopt the Commissioner's evidentiary and primary findings relating to nonequivalence, comparative inoperativeness and nonsuggestiveness, the Court of Claims erred, and by not thereafter making any evidentiary or primary findings as to those same material issues, the Court of Claims did not apply the correct facts to the test of obviousness. For this reason the decision below is in conflict with the decisions of this Court, and should be reversed.

Conclusion

For these reasons, a writ of certiorari should issue to review the judgment, opinion and findings of the United States Court of Claims.

Respectfully submitted,

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July 16, 1970

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Appendix A

IN THE UNITED STATES COURT OF CLAIMS

No. 274-64

(Filed January 23, 1969.)

DECCA, LIMITED v. THE UNITED STATES

REPORT OF COMMISSIONER TO THE COURT*

Robert B. Russell, attorney of record for plaintiff. *Charles E. Pfund* and *Richard J. Birch*, of counsel.

Joseph A. Hill, with whom was *Assistant Attorney General Edwin L. Weisl, Jr.*, for defendant. *Nick G. Kalokathis*, of counsel.

OPINION

LANE, *Commissioner:* This is a patent suit under Title 28 U.S.C. § 1498, in which plaintiff seeks to recover reasonable and entire compensation for the alleged unauthorized use by or for the defendant of inventions in the field of electronic aids to navigation as set forth in U.S. Letters Patent Nos. 2,598,290, 2,582,350, 2,578,980, and 2,568,250. Plaintiff is the owner of record of said patents. The liability issue, including patent infringement and patent validity issues, is before the court, and any accounting issues are deferred until the question of liability has been determined. Plaintiff alleges that patent claims 15-19,

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* The opinion, findings of fact, and recommended conclusions of law are submitted under the order of reference and Rule 57(a).

inclusive, of the '290 patent, claim 3 of the '350 patent, claims 1, 2, 3, 6, and 7 of the '980 patent, and claim 1 of the '250 patent have been infringed by the defendant's use of "Loran-C" navigation systems and the manufacture of equipment for use in said systems.

It is concluded that claim 3 of the '350 patent and claim 1 of the '250 patent are invalid; that claims 15-19, inclusive, of the '290 patent, and claims 6 and 7 of the '980 patent have not been infringed by defendant; and that claims 1, 2, and 3 of the '980 patent are each valid and infringed.

This litigation involves electronic apparatus for use in navigation, apparatus of the type known as hyperbolic radio navigation systems. In the operation of such systems, separate transmitting stations fixed at known locations radiate radio signals which are sensed by a mobile receiver located at a position remote from the transmitters. The transmitting stations are synchronized to radiate radio frequency signals in a fixed time ralationship. The mobile receiver picks up the signals and measures the time difference of the signals from the separate transmitting stations. Such signals are usually in the radio frequency range of about 60 to 100 kilocycles per second. By measuring the time difference between signals received from a first pair of transmitting stations, the mobile receiver is capable of determining a first hyperbolic line of position on which the receiver is located. A hyperbolic line is a curved line formed by a series of points each located at a constant difference in distance from two fixed points, *i. e.*, from two fixed transmitting stations. The mobile receiver also measures the time difference between the signals received from a second pair of fixed transmitting stations and determines a second hyperbolic line of position. The intersection of the first and second lines of position pin-

points the current location of the mobile receiver relative to the several transmitting stations.

In one type of hyperbolic navigation system, the signals radiated from the transmitting stations are continuous wave signals, *i.e.*, signals in the form of sine or regular waves having a fixed frequency. In such a system, the time difference is determined by measuring the difference in the phase of the continuous wave signals received from the separate transmitting stations. In another type of hyperbolic navigation system, the signals are radiated in the form of pulses or bursts spaced apart by fixed time intervals. In this second system, the mobile receiver measures the time difference between the arrival of the pulses or bursts from the separate transmitters. In both types of systems, time difference measurements are made to determine the current position of the mobile receiver in relation to the known locations of the transmitting stations. The continuous wave (CW) system measures the difference in phase, whereas the pulse system measures the time difference directly, in order to ascertain the position of the receiver.

Patent 2,598,290

The '290 patent discloses an area identification system in which transmitting stations radiate modulated carrier signals. A radio frequency carrier signal is modulated by impressing another signal such as an audiofrequency signal on the carrier frequency signal to produce a regular alteration of the frequency or the amplitude of the frequency. Each of the carrier signals is modulated by the same modulation frequency, a signal in the form of a single sine wave. The mobile receiver performs two phase difference measurements. By measuring the difference in phase between

the modulation components of the signals, the receiver provides a coarse indication of its location with respect to the fixed transmitting stations. By measuring the phase difference between the carrier components of the signals, the receiver provides a fine indication of its location. At trial, plaintiff relied upon claim 19 of the '290 patent. This patent claim reads as follows:

> [19] In a position determining system,
>
> (a) spaced transmitters for radiating waves each comprising carrier and modulation components,
>
> (b) means at a receiving point responsive to the modulation components of said waves for providing an indication which represents within a predetermined range the position of said receiving point relative to at least one of said transmitters, and
>
> (c) means at said receiving point responsive to the carrier components of said waves for providing a second indication accurately representative of the position of said receiving point within said predetermined range,
>
> thereby accurately to define the position of said receiving point relative to said one transmitter.

The defenses asserted by the defendant include invalidity of the '290 patent under Title 35 U.S.C. § 103 in view of the prior art, invalidity of the '290 patent under Title 35 U.S.C. § 102(a) and § 102(g) as anticipated by low frequency Loran, invalidity of the '290 patent under Title 35 U.S.C. § 101, and noninfringement of the '290 patent by the Loran-C navigation system. It is concluded that the Loran-C system does not infringe claims 15-19 of the '290 patent. No conclusion is made regarding the other defenses raised by the defendant.

In determining the issue of patent infringement, it is well settled law that in the first instance resort must be

made to the language of the patent claim. *Graver Tank & Manufacturing Co.* v. *Linde Air Products Co.*, 339 U.S. 605 (1950). The literal words of the patent claim constitute, however, only the starting point in the determination of this issue. The state of the prior art and the prosecution history of the patent application in the Patent Office are also important factors which must be considered in determining the meaning of a patent claim. *Graham* v. *John Deere Co.*, 383 U.S. 1, 17 (1966). Unless the patented invention is identical, in all respects, to the accused arrangement, the proper interpretation which is to be accorded to the language of the patent claim must be decided before the infringement issue can be resolved. Where a patented and accused device are not identical, it is necessary to consider the structure, operation, and result obtained by each device. *Machine Co.* v. *Murphy*, 97 U.S. 120, 125 (1877), sets forth the traditional principle of infringement: "if two devices do the same work in substantially the same way; and accomplish substantially the same result; they are the same, even though they differ in name, form, or shape." This principle is the basis for the doctrine of equivalents which is the standard for interpretation of language appearing in patent claims.

The doctrine of equivalents determines the scope of protection provided by patent claims which define the patent monopoly awarded to an inventor upon the issuance of his patent. This doctrine also establishes the limits on the protection available to a patent owner. Devices which are equivalents of the invention defined by a patent claim are encompassed within the claim. The claim cannot, however, be interpreted to encompass a device which is not the equivalent of the defined invention. The doctrine must be considered in every case in which the issue of patent in-

fringement is involved. Literal infringement of a patent claim is not sufficient to establish liability for patent infringement. A device may be so far changed in principle from a patented device that it performs the same or similar function in a substantially different way, even though it falls within the literal words of the claim. In this case, the doctrine of equivalents may be used to restrict the claim and defeat the patentee's action for infringement. *Westinghouse v. Boyden Power Brake Co.*, 170 U.S. 537, 568 (1898).

Claim 19 of the '290 patent defines a position determining system as a combination of elements in which two of the elements are set forth as means for performing desired functions. There is no recitation of any specific structure for performing those functions. In this situation, the structure disclosed in the specification of the patent must be considered, and the patent claim will be construed to cover the disclosed structure and equivalents of that structure. *Stearns v. Tinker & Rasor*, 252 F. 2d 589, 116 USPQ 222 (9th Cir. 1957).

The system disclosed in the '290 patent is a continuous wave system which employs a master transmitting station and two slave stations. The master station radiates a carrier frequency of 60 kilocycles per second (kc) which is modulated at an audiofrequency of 2,400 cycles per second (cps). The first slave station receives the modulated 60 kc signal from the master station and converts this signal to an 80 kc carrier frequency. The 80 kc carrier frequency is also modulated at an audiofrequency of 2,400 cps, and the modulated 80 kc signal is radiated from the first slave station. Similarly, the second slave station receives the modulated 60 kc signal and converts it to a 90 kc slave signal with an audiomodulation of 2,400 cps.

The mobile receiver employed in the system disclosed in the '290 patent receives the master and slave signals simultaneously. The receiver is provided with frequency converters for converting the 60 kc and 80 kc carrier frequencies to 240 kc signals and for converting the 60 kc and 90 kc carrier frequencies to 180 kc signals. The receiver performs a phase difference measurement on the 240 kc signals to provide an indication of the difference in phase between the 60 kc master signal and the 80 kc slave signal. It also measures the phase difference between the 180 kc signals to provide an indication of the difference in phase between the 60 kc master signal and the 90 kc slave signal. In addition, the receiver is designed to measure the phase difference between the 2,400 cps modulations impressed on the master and slave carrier frequencies.

In the operation of the system disclosed in the '290 patent, the carrier frequencies transmitted from the master station and the first slave station define a first set of hyperbolic lines of zero phase difference, *i.e.*, lines along which the receiver senses no phase difference between the carrier frequencies. In the sector between two adjacent lines of zero phase difference, the phase relation of the carrier frequencies varies from zero degrees (0°) to 360°. The carrier frequencies transmitted from the master and the second slave stations define a second set of hyperbolic lines of zero phase difference which intersect the lines of the first set.

The mobile receiver determines its position relative to the transmitting stations by identifying the intersections of the hyperbolic lines. A course determination of receiver position is made by measurement of the phase difference of the modulation components of the transmitted signals. This measurement on the modulation components determines the

position of the receiver within a sector bounded by lines of zero phase difference which are established by the carrier frequency components. A fine determination of receiver position is made by measurements of the phase difference of the carrier components to accurately identify the position of the receiver within the sector. In order to achieve accurate position determination, the measurement performed by the receiver on the modulation components must provide an unambiguous identification of the sector within which the receiver is located. The fine position determination is made in relation to adjacent hyperbolic lines of zero phase difference. It only becomes meaningful when the hyperbolic lines defining the sector are uniquely identified. To facilitate unique identification of the hyperbolic lines, the transmitting stations are arranged so that the slave stations are spaced from the master station by distances equal to one wavelength of the modulation frequency. With this arrangement, the phase difference measurement of the modulation components permits the determination of a unique receiver position from which the hyperbolic lines bordering the sector of receiver position may be identified.

In construing the terminology of claim 19 of the '290 patent, it is noted that the patent specification discloses frequency converters and phase comparison circuitry in the receiver which correspond to the claim language "means at a receiving point responsive to the modulation components of said waves * * *." Furthermore, the receiver includes additional phase comparison circuitry which corresponds to the language of the claim which recites "means at said receiving point responsive to the carrier components of said waves * * *." The comparison circuitry in the receiver performs phase difference measurements on the carrier and modulation components of signals received by the receiver

to determine the receiver position. The prior art pertinent to the '290 patent is listed in finding 7 and shows that hyperbolic position determining systems were known at the time of the invention of the subject matter of the '290 patent. The Shanklin patent[1] discloses a position indicating system in which receiver position is determined by measuring the phase relation of modulation components of radio signals. The German Harms patent[2] discloses an unmodulated system wherein the receiver is responsive to carrier frequencies. In addition, the Shanklin patent indicates that a more accurate position determination may be obtained by impressing modulation frequencies which are multiples of the first modulation frequency on the carrier waves. Shanklin demonstrates the concept of coarse and fine position determination in a hyperbolic system but does not indicate that coarse position determination may be derived from the modulation components and fine position determination from the carrier components.

The prosecution history of the '290 patent shows that patent claim 19 was copied from an issued patent in order to provoke an interference between the '290 patent application and that patent. The Patent Office refused to allow the applicant to copy another claim from the patent which called for "modulation components of different frequencies * * *" because the '290 specification disclosed only one modulation frequency and could not support such a claim. Pursuant to the rejection of the claim by the Patent Office, applicant amended the claim to eliminate the recitation of different modulation frequencies, and the amended claim was then allowed. Although this claim is not relied upon to establish patent infringement, its prosecution history

[1] Shanklin ..... 2,144,203 ..... January 17, 1939
[2] Harms ..... German 546,000 ..... March 8, 1932

may be considered in determining the scope of the invention sought to be protected by the claims of the patent. *Graham v. John Deere, supra.* The prosecution history of the '290 patent indicates that the invention of the '290 patent contemplated a navigation system in which carrier signals were modulated at a single modulation frequency.

Loran-C Navigation System

Loran-C, the alleged infringing system, is a hyperbolic navigation system in which pulses are radiated from transmitting stations. The pulses are in the form of bursts of 100 kc carrier frequency signals. The transmitting stations are synchronized to radiate pulses at predetermined time intervals so that a mobile receiver responsive to the pulses does not detect any overlap in the received pulses. The receiver of the Loran-C system measures the time difference in arrival of pulses from master and slave stations to provide a coarse indication of the receiver position relative to those stations. The receiver also measures the difference in phase between the carrier signals which form the pulses to provide a more precise determination of the position of the receiver. In order to measure the time difference between the received pulses, the receiver employs circuitry for generating sampling trigger signals which correspond to the received master and slave pulses. The trigger signals are aligned with predetermined sampling points on the master and slave pulses, and the receiver provides a direct indication of the amounts of time by which the trigger signals must be shifted to align the trigger signals with the sampling points on the pulses. The phase difference on the carrier frequencies is measured by synchronizing a 100 kc oscillator at the receiver with the carrier frequency (100 kc) of the received master

pulse. The receiver circuitry then measures the difference in phase between the signal from the reference oscillator and the carrier frequencies of the pulses received from the slave transmitters. The receiver provides a direct indication of this phase difference. The 100 kc reference oscillator is required because the Loran-C transmitting stations are synchronized so that no overlap in the transmitted pulses is detected by the receiver.

A comparison of Loran-C and the system of the '290 patent shows that both systems are concerned with hyperbolic navigation arrangements in which coarse position determination is derived from the modulation components of transmitted radio signals and fine position determination is derived from the carrier components of the signals. In Loran-C the carrier components have a frequency of 100 kc and the modulation components consist of the pulse repetition rate impressed on the 100 kc carriers. In the system of the '290 patent, the carrier components are 60 kc, 80 kc, and 90 kc, and the 2,400 cps signals impressed on the carriers are the modulation components. A difference between the systems is that the system of the '290 patent employs modulation components in the form of continuous waves while Loran-C employs modulation components in the form of pulses. This difference accounts for a difference in the operating ranges of the two systems. The system of the '290 patent has an operating range of 100 to 150 miles, while Loran-C is capable of operating over a range of 500 to 1,200 miles. Because the '290 system radiates continuous wave signals, the signals radiated from the transmitting stations cannot be distinguished from the signals reflected from the ionosphere (sky waves) by a mobile receiver located at a distance from the transmitting stations. The effect of sky waves on the opera-

tion of the '290 system severely limits the distance over which the system is operative. The pulse transmission employed in the Loran-C system allows the effect of sky waves on the system to be eliminated. The receiver of Loran-C bases its measurements on the leading edge of each received pulse. Since this portion of the pulse arrives at the receiver before any reflected signals (sky waves), the measurement is free of any sky wave interference. Thus, although the '290 system and Loran-C are concerned with similar objectives, the Loran-C system achieves substantially better results by employing pulse modulation to eliminate the effects of sky waves on the system operation.

Patent '290 Not Infringed by Loran-C

A detailed comparison of the components of Loran-C and the system of the '290 patent and the operation of the respective components shows that the two systems achieve hyperbolic navigation in substantially different ways. The plaintiff's charge of infringement is not supported in this instance. Although both systems employ modulation components in the determination of mobile receiver position, the pulse modulation of Loran-C is not equivalent to the continuous wave modulation taught by the '290 patent. Pulse modulation in Loran-C allows sky wave interference to be eliminated and requires that the receiver in the system operate in a manner completely different from the receiver operation in the '290 patent. The circuitry in the Loran-C receiver for generating sampling trigger signals and aligning the trigger signals with the received pulses operates on principles entirely different from the operation of the frequency converters and phase comparison circuitry disclosed in the '290 patent. In Loran-C, the fact that the pulses are received at different times requires that trigger circuitry be

employed in the receiver to perform the time different measurement on the pulses. In the system of the '290 patent, phase comparison circuitry is used because the continuous wave signals are received simultaneously. To make a phase difference measurement on the carrier signals of the pulses, the Loran-C receiver must use a local reference oscillator because the carrier signals do not overlap at any time and phase difference measurement by direct comparison of the carrier signals is impossible. This is not true of the receiver of the '290 patent because the signals are received simultaneously.

Another difference between the two systems is in the manner in which unique identification of receiver position is achieved. In the '290 system, the transmitting stations are arranged so that the slave stations are spaced at equal distances from the master station by distances equal to the wavelength of the modulation frequency impressed on the carrier components. In the Loran-C system no special relationship between station spacing and pulse repetition rate is required.

In view of the differences between Loran-C and the '290 patent, it is concluded that defendant has not infringed claim 19 of the '290 patent by using Loran-C systems or by having equipment manufactured for use in Loran-C systems. The language of claims 15-18 of the '290 patent is substantially similar to that of claim 19, and it is further concluded that defendant has not infringed claims 15-18.

Patent 2,582,350

Plaintiff contends that defendant has infringed claim 3 of the '350 patent. This patent describes a radio navigation system in which synchronized radio signals of different but

related frequencies are radiated from transmitting stations to provide a hyperbolic pattern of position lines along which the transmitted signals are in constant phase relation. The system employs a receiver responsive to the transmitted signals to measure the phase difference between the signals to identify the hyperbolic position on which the receiver is located.

Claim 3 of the '350 patent defines a *method* of measuring the phase relation between two synchronized radio waves which is performed by the receiver disclosed in that patent. Patent claim 3 of the '350 patent reads as follows:

> [3] The method of measuring the phase relation between two synchronised radio waves radiated from spaced locations at a point remote from said locations which consists in
>
> (a) separately receiving each of said waves,
>
> (b) amplifying each of said received waves to provide two radio frequency signals,
>
> (c) adding said signals to provide one alternating potential of radio frequency,
>
> (d) subtracting one of said signals from the other to provide a second alternating potential of radio frequency,
>
> (e) separately rectifying said alternating potentials to provide corresponding direct potentials, and
>
> (f) comparing said direct potentials,
>
> whereby a measurement of said phase relation is obtained.

The transmitting stations of the '350 patent radiate synchronized radio waves having different frequencies. The receiver is provided with channels for separately receiving the radio waves. The receiver channels include amplifying circuits for converting the received radio waves to signals of the same radio frequency. A phase comparison is per-

formed on the derived signals by applying the sum of the signals to a first rectifier, by applying the difference between the signals to a second rectifier, and by comparing the rectified potentials provided by the rectifiers to obtain a measurement of the phase relation of the signals.

The defenses asserted by the defendant with respect to the '350 patent are that patent claim 3 is invalid under Title 35 U.S.C. § 102(b), invalid under § 103, invalid because it recites the inherent operation of the apparatus disclosed in the patent, and that patent claim 3 has not been infringed. It is concluded that patent claim 3 of '350 is invalid under § 103, and that no conclusions need be made with respect to the other defenses raised by defendant.

Patent Claim 3 of '350 Invalid

In support of its defense that claim 3 is invalid, defendant has cited the patents to Affel [3] and Harms. The Affel patent discloses a position indicating system in which synchronized radio signals are radiated from spaced transmitting locations. The signals are synchronized by the common source of radio frequency energy used for the transmitting locations. The receiver disclosed in the Affel patent employs a pair of directional antennas for separately receiving the radio signals. The received signals are applied to amplifying devices which provide signals of constant amplitude. The signals from the amplifying devices are applied to the phase comparison circuitry of the receiver. The phase comparison circuitry disclosed in the Affel patent operates on the same principles of phase comparison set forth in the '350 patent. The arrangement of circuitry is such that the constant amplitude signals are combined by addition and subtraction, and the resultant

[3] Affel ..... 1,562,485 ..... November 24, 1925

sum and difference signals are applied to a balanced modulator which produces a direct current output corresponding to the relative phase of the input signals. The description of the phase comparison circuitry in the Affel patent is not sufficiently detailed to permit a conclusion that its operation is identical to the operation of the '350 patent system. The Affel patent does disclose a method of comparing the phase relation between two synchronized radio signals in which the signals are separately received and amplified to provide radio frequency signals on which a phase comparison is performed.

Defendant has also cited prior art patents to establish that the portion of claim 3 which describes the phase comparison method, *i.e.*, the steps of the claim beginning with "adding said signals . . . ." was known in the art at the time that the invention of the '350 patent was made and, further, that these steps describe the principles of operation of any known phase comparison circuit. The Runge patent [4] discloses a phase comparison circuit in which the vector sum and difference of two signals to be phase compared are applied to rectifiers which provide direct current outputs. The rectifier outputs are compared to indicate the phase relation of the signals. The fact that the Runge patent discloses comparison of the rectifier currents while the '350 patent discloses a comparison of the potentials on the rectifiers is not significant. The Curtis [5] and Purington [6] patents both disclose phase comparison circuits which operate on the same principles as described in the operation of the '350 patent. In addition, both patents describe a comparison of rectifier potentials to obtain an indication of phase relation.

[4] Runge	2,028,880	January 28, 1936
[5] Curtis	2,231,704	February 11, 1941
[6] Purington	2,281,995	May 5, 1942

Title 35 U.S.C. § 103 provides that a patent may not be obtained if the subject matter as a whole would have been obvious, at the time the invention was made, to a person having ordinary skill in the art to which said subject matter pertains. The Supreme Court stated in *Graham v. John Deere, supra*, that the issue of patent invalidity under § 103 lends itself to several basic factual inquiries including the scope and content of the prior art, differences between the prior art and the claim at issue, and the level of ordinary skill in the pertinent art. The prior art in this case shows that, in the art of radio navigation, it was known at the time the invention was made to measure the phase relation of synchronized radio waves by separately receiving the waves, amplifying the received waves, and performing a phase comparison measurement on the amplified waves. This is disclosed by the Affel patent which also suggests that the phase comparison may be performed by an arrangement similar to that described in the '350 patent. The Runge and Curtis patents disclose phase comparison circuits which operate in substantially the same manner as the method of phase comparison taught in the '350 patent and which circuits are utilized in the art of radio transmission. No evidence, other than the prior art patents and the expert testimony relating to the patents, has been presented to establish the actual level of ordinary skill existing in the art at the time the method of the '350 patent was disclosed.

Claim 3 of the '350 patent is invalid because, at the time of the invention, it would have been obvious to a person having ordinary skill in the radio navigation art to incorporate the phase comparison circuit of the Runge patent in the receiver of the Affel patent to obtain a device which would operate in accordance with the method of claim 3. The Affel patent suggests that a phase comparison circuit

in which the signals to be phase compared are combined to produce summation and difference signals may be employed in a receiver in a radio navigation system. It would have been within the exercise of ordinary skill in the art to substitute the phase comparator of the Runge patent for the corresponding circuitry of the Affel receiver. In view of the scope of the prior art, the differences between the prior art and the '350 patent, and the level of ordinary skill in the art as indicated by the prior art, it is concluded that claim 3 of the '350 patent is invalid under § 103 of the patent statute.

In view of invalidity under § 103, it is not necessary to reach a conclusion on the question of whether or not claim 3 is infringed by the Loran-C system. It is noted that the evidence presented by the plaintiff with respect to infringement is not sufficient to establish that claim 3 has been infringed. Plaintiff's evidence consisted of expert testimony relating to pages from a Government manual illustrating *circuits* in equipment procured by the Government. The expert testimony pointed out that the illustrated circuits contained elements corresponding to the language of the patent specification. The explanation of the circuits is insufficient to prove that circuit operation is substantially the same as the method set forth in claim 3 of the '350 patent.

Patent 2,578,980

Plaintiff contends that defendant has infringed claims 1, 2, 3, 6, and 7 of the '980 patent in using its Loran-C navigation system and in procuring the manufacture of equipment for use in that system. The system of the '980 patent is a hyperbolic navigation system in which receiver position is determined by measuring the time difference in

arrival of synchronized pulses originating at fixed transmitting stations. The transmitting stations operate on a common carrier frequency of 100 kc. Pulse modulation at identical repetition rates is impressed on the carrier frequencies. The durations of the pulses are uniform. An important aspect of the 980 system is synchronization. The pulses and the carrier frequencies of the transmitting stations are maintained in fixed time relationships. In order to accomplish synchronization, one of the fixed stations is operated as a master station and the remaining stations are operated as slaves. The slave stations are provided with devices for receiving the pulses transmitted from the master station. The receiving devices are connected to slave oscillators and said oscillators operate in synchronism with the carrier components of the received master pulses. The signals produced by the oscillators are pulse modulated at a fixed repetition rate and a predetermined time delay is inserted into the pulse modulation. The resulting pulses are applied to transmitting antennas at the slave stations. To maintain the transmitted pulses in synchronism with the master pulses, the transmitting equipment of each slave station is provided with phase regulating circuitry for controlling the phase of the carrier components of the slave pulses. This circuitry includes a phase discriminator, which performs a phase comparison, and a phase regulator operated by the phase discriminator. The phase discriminator measures the difference in phase between the carrier components of the slave pulses and the signal derived from the slave oscillator. Since the oscillator operates in synchronism with the carrier components of the master pulses, the phase discriminator, in effect, measures the phase difference in the carrier components of the master and slave pulses. The phase regulator adjusts the phase of the carrier components of the slave pulses in

response to the phase measurement made by the discriminator to maintain the master and slave carrier components in a fixed phase relation.

In the system disclosed in the '980 patent, the mobile receiver includes a cathode ray oscilloscope which displays the master and slave pulses on a spiral trace. The time difference in arrival of the pulses at the receiver is determined by measuring the distance along the spiral trace which separates the master and slave pulses.

Patent claim 1 of the '980 patent defines a radio frequency navigation system and reads as follows:

> [1] In a radio frequency navigation system, the combination of:
>
> (a) a master and a slave transmitting station spaced from each other;
>
> (b) transmitting means at each of said stations for radiating therefrom carrier waves of like frequency pulse modulated at identical pulse recurrence rates and like pulse durations;
>
> (c) receiving means at said slave stations for receiving the radiations from said master station;
>
> (d) a phase discriminator at said slave station coupled to the transmitting means thereat and to said receiving means responsive to the phase relation between the carrier waves radiated from said master and said slave stations;
>
> (e) and a phase regulator coupled to the transmitting means at said slave station and actuated by said phase discriminator for maintaining fixed the phase relation of said carrier waves.

Patent claim 2 of the '980 patent differs from claim 1 by adding:

> [f] and means for delaying the radiation of each pulse from said slave station a fractional part of said pulse separation period.

Patent claim 3 of the '980 patent differs from claim 1 by adding:

> [f] and a mobile receiving apparatus including means for receiving the radiations from said stations,
>
> [g] and time measuring means actuated by said receiving means for measuring the difference in time between the reception of pulses from each of said stations.

Patent Claims 1, 2, and 3 of '980 Valid and Infringed

Defendant contends that claims 1, 2, and 3 of the '980 patent are invalid under Title 35 U.S.C. § 102 or § 103. In support of its contentions, defendant relies on prior art patents and a report disclosing a navigation system known as LF Loran which was developed subsequent to the Loran-A system. It concluded that the invention set forth in patent claims 1, 2, and 3 is neither anticipated by nor rendered obvious in view of the prior art. It is further concluded that claims 1, 2, and 3 of the '980 patent have been infringed by the defendant.

In determining whether or not a patent claim is anticipated by the prior art, the test to be applied is whether a prior art reference contains adequate directions for practicing the subject matter defined in the patent claim. *Straussler* v. *United States*, 168 Ct. Cl. 852, 143 USPQ 443 (1964). In order to anticipate a patent claim, a reference must disclose all the elements of a claimed combination, or their mechanical equivalents, which function in substantially the same way to produce substantially the same result. *Straussler* v. *United States*, *supra*; *Greening Nursery Co.* v. *J. & R Tool & Mfg. Co.*, 376 F. 2d 738, 153 USPQ 660 (8th Cir. 1967).

The defendant specifically asserts that claims 1, 2, and 3 of the '980 patent are anticipated by the LF Loran system under §§ 102(a), 102(b), and 102(g) of the patent statute. These claims are directed to a radio navigation system in which pulse modulated signals are transmitted from master and slave transmitting stations. The claims specifically recite a phase controlling arrangement at the slave transmitting station for maintaining the carrier components of the slave pulses in synchronism with the master station carrier components. The claimed arrangement consists of a phase discriminator responsive to the master and slave carrier signals and a phase regulator operated by the phase discriminator. In comparing the LF Loran system with the system defined by the patent claims, it is found that LF Loran does not incorporate the combination of a phase discriminator and a phase regulator to control the phase of the slave carrier signal. Synchronization of the slave transmitting station in LF Loran is accomplished manually by an operator who observes the master and slave carrier signals on an oscilloscope and adjusts the slave oscillator until the master and slave signals appear in synchronism on the oscilloscope. The apparatus of LF Loran and that of the '980 patent for achieving synchronism between the master and slave carrier signals are different and are not equivalents. Defendant's contention that the *person* operating the transmitting equipment at the slave station is equivalent to the *phase discriminator and phase regulator combination* of the '980 patent is without merit. It is concluded that claims 1, 2, and 3 of the '980 patent are not anticipated by LF Loran under § 102 of the patent statute.

Considering the question of patent validity raised by the defendant under § 103 of the patent statute, the starting point is the factual inquiry prescribed by the Supreme

Court in *Graham* v. *John Deere, supra.* The prior art in this instance consists of the Runge patent, the British O'Brien patent,[7] and the LF Loran system. The Runge patent discloses an arrangement in which carrier signals radiated from separate master and slave transmitters are synchronized. Synchronization is accomplished by a phase comparison device at a slave station which controls the phase of the signals radiated from the slave transmitter. The phase comparison device measures the difference in phase between the carrier signals of the slave transmitter and the carrier signals of the master transmitter. The signals from the master transmitter are applied to the phase comparison device by a cable extending between the master and slave stations. The arrangement of the Runge patent is limited to synchronization of continuous waves, and there is no disclosure of any arrangement for synchronizing the carrier components of pulses transmitted from separate stations. The British O'Brien patent discloses a phase controlling circuit which contains a phase discriminator and a phase regulator controlled by the discriminator. It is specified in the British patent that the circuit may be employed in the radio transmitters of a navigation system in order to maintain the transmitters in a controlled phase relation. The circuit functions to maintain a fixed phase relation between the current flowing in a transmitting antenna and the voltage applied to the antenna. There is no suggestion in the British patent of the manner in which the phase controlling circuit might be incorporated into a pulse transmitting system to hold the carrier components of pulses radiated from separate transmitting stations in a fixed phase relation.

Defendant contends that the circuitry of the '980 patent for providing synchronization of the master and slave car-

[7] O'Brien ..... British 579,170 ..... April 13, 1942

rier signals would have been obvious to a person having ordinary skill in the art in view of either the Runge patent or the British O'Brien patent. Defendant asserts that the problem of synchronization solved by the '980 patent merely involved the synchronization of the signals appearing at two separate points in the slave transmitting equipment. Defendant's analysis of the problem is too narrow. The '980 patent is directed to an arrangement for automatically synchronizing the carrier components of pulses radiated from separate transmitting stations. The prior art does not contain any disclosure of a pulse system in which the synchronization of carrier components is accomplished automatically. In LF Loran an operator located at the slave station observes master and slave signals on an oscilloscope and manually adjusts a slave oscillator until the signals are in synchronism. There is no arrangement provided for maintaining synchronization of the master and slave signals in the absence of an operator at the slave station. The Runge patent is concerned with synchronization of carrier frequencies in a continuous wave system. It does not disclose an arrangement which would be operative if the transmitted signals were in the form of pulses since there would be no overlap of master and slave signals during which a phase comparison could be performed on the carrier components of the master and slave pulses. In addition, the Runge patent does not disclose any receiving means which responds to radiations from the master station. The signals from the master station are applied to the slave transmitting equipment by a cable extending between the stations. The Runge patent is not concerned with a pulse transmission system and does not suggest a solution to the problem of carrier synchronization in such a system. It is concluded that the invention defined in claims 1, 2, and 3 of the '980 patent would not have been obvious

to a person having ordinary skill in the art in 1946 in view of the Runge patent.

The British O'Brien patent discloses a phase controlling circuit which maintains the output of a transmitting antenna in a fixed phase relation with respect to the input applied to that antenna. The circuit includes a phase discriminator and phase regulator combination which operates to maintain the signals appearing at separate points in the transmitting equipment in synchronism. Defendant asserts that this is precisely the manner in which the system of the '980 patent functions to achieve synchronism between the carrier components of the master and slave pulses. On the basis of this analysis, defendant concludes that the solution to the problem of carrier synchronization presented in the '980 patent would have been obvious to a person of ordinary skill in the art within the meaning of § 103 of the patent statute. Defendant's conclusion is based on an oversimplification of the problem of carrier synchronization in a pulse transmission system. Although the synchronization may be ultimately accomplished by a phase controlling circuit which synchronizes the signals appearing at separate points in the transmitting equipment, there are other functions which must be performed prior to the operation of the phase controlling circuit. The pulses radiated from the master station must be received at the slave transmitting equipment, and a phase comparison must be performed on the carrier components of master and slave pulses which do not overlap in time. The British O'Brien patent is not concerned with synchronizing carrier components of pulses radiated from separate transmitting stations and it does not suggest any manner in which its phase controlling circuitry might be employed to accomplish synchronism in that situation. Because of the differ-

ences between the British patent and the system set forth in claims 1, 2, and 3 of the '980 patent, it is concluded that these claims do not define an invention which would have been obvious under § 103 of the patent statute.

In asserting invalidity of the '980 patent, defendant contends that it would have been obvious to modify the LF Loran equipment in view of either the Runge patent or the British O'Brien patent in order to achieve the invention defined in claims 1, 2, and 3 of the '980 patent. It is defendant's contention that the '980 patent merely substituted a known combination, *i.e.*, a phase discriminator and phase regulator, for an existing manual arrangement in the LF Loran system for maintaining signals in a fixed phase relation. For this reason, defendant maintains that the '980 patent does not constitute an invention in view of the prior art. As mentioned above, synchronization in the LF Loran system is performed by an operator who observes signals on an oscilloscope and adjusts a slave oscillator until the observed signals are in synchronism. The British O'Brien patent discloses a combination including a phase discriminator and a phase regulator for maintaining the input and output signals of a transmitting antenna in a fixed phase relation. Without the benefit of hindsight obtained from the '980 patent, there is no instruction or suggestion in the prior art of the manner in which the phase discriminator and phase regulator of the British patent might be incorporated into the LF Loran system in order to achieve synchronism between the carrier signals radiated from separate transmitting stations. The '980 patent provides the necessary instruction for coupling the phase discriminator to the slave transmitting antenna and to the receiver at the slave station which responds to signals from the master station. The Runge patent is only concerned with the

synchronization of continuous wave signals and does not contain instructions relevant to the synchronization of carrier signals in a pulse transmission system. It is concluded that the invention set forth in claims 1, 2, and 3 of the '980 patent would not have been obvious in 1946 to a person of ordinary skill in the art.

Defendant's contention that the '980 patent does not constitute an invention because it merely provides an automatic means to replace a manual activity used in the prior art to accomplish the same result is not supported in this case. Without deciding the validity of the proposition for which defendant cites the case of *In re Venner and Bowser*, 262 F. 2d 91, 46 CCPA 754, 120 USPQ 192 (1958), it is concluded that the incorporation of automatic phase controlling circuitry in a pulse transmission system does not constitute the mere substitution of automatic means for a known function previously performed by manual activity. The phase discriminator and phase regulator of the '980 patent operate in a manner substantially different from the activity of an operator who manually controls the transmitting operation.

Plaintiff's contention that the invention of the '980 patent is entitled to an invention date in the United States prior to the filing date of the application for patent is not considered in view of the conclusion that claims 1, 2, and 3 are not anticipated by or rendered obvious in view of the prior art. Defendant's assertions with respect to the effective publication date of its report describing LF Loran and the public use of the LF Loran system are not considered in view of the conclusions that LF Loran does not anticipate the claims of the '980 patent under § 102 of the patent statute or render the claimed invention obvious under § 103.

Where the accused apparatus is substantially identical in structure, mode of operation, and result to apparatus defined in patent claims, patent infringements is established. *Eastern Rotorcraft Corp. v. United States*, 384 F. 2d 429, 181 Ct. Cl. 299, 155 USPQ 729 (1967); *Texsteam Corp. v. Blanchard*, 352 F. 2d 983, 147 USPQ 431 (5th Cir. 1965), *cert. denied*, 387 U.S. 936 (1967). Defendant's Loran-C navigation system is substantially identical in structure, mode of operation, and result to the structure defined in claims 1, 2, and 3 of the '980 patent in suit. These patent claims are directed to the combination of master and slave transmitting stations which radiate pulse modulated carrier signals and a phase discriminator and phase regulator at the slave station for maintaining the master and slave carrier signals in synchronism. Loran-C includes all of the several elements set forth in these patent claims operating in substantially the same way to produce substantially the same result. It is concluded that claims 1, 2, and 3 of the '980 patent have been infringed by the defendant in its use of its Loran-C navigation system and in procurement of equipment for use in that system.

Patent Claims 6 and 7 of '980 Not Infringed

Patent claim 6 of '980 recites a radio frequency navigation system including a first stable crystal oscillator and a frequency dividing phase shaping circuit at the master transmitter station and a second stable crystal oscillator and phase shaping circuit at the slave transmitter station and need not be reproduced here in full text. Patent claim 7 of '980 recites a radio navigation aid in which the number of carrier wave cycles in each pulse is less than 100 and in which the time spacing between pulses is at least 3 times the duration of each pulse and also is not reproduced here in its full text.

In response to plaintiff's charge that claim 6 of the '980 patent has been infringed, defendant urges that claim 6 is invalid under Title 35 U.S.C. §.103 in view of the prior LF Loran system and that it is also invalid under § 102 in view of the prior Snow patent.[8] It is concluded that claim 6 of the '980 patent is not infringed by the Loran-C navigation system. In view of this conclusion, the contentions of the defendant with respect to invalidity need not be considered.

In determining the issue of patent infringement, the first step is to consider the specific language of the patent claim. *Dvorsky v. United States*, 173 Ct. Cl. 638, 148 USPQ 87 (1965). The state of the prior art and the prosecution history should also be considered in interpreting that language. *Graham v. John Deere*, *supra*.

Patent claim 6 of '980 relates to the synchronization of master and slave transmitting stations in a radio navigation system. This claim recites the two aspects of the synchronization employed in the '980 patent, *i.e.*, synchronization of the carrier signals radiated from the transmitting stations and synchronization of the pulse modulation impressed on the carrier signals. At the master transmitting station, a first crystal oscillator as the source of the master carrier signal and a frequency dividing circuit coupled to the oscillator provides the pulse modulation which is impressed on that signal. A second crystal oscillator at the slave transmitting station of the slave carrier signal. A receiving device at the slave station responds to the carrier signal transmitted from the master station. The receiving device is coupled to the second oscillator and functions to maintain the second oscillator in synchronism with the first oscillator. In this arrangement, the second oscillator is *sucked in* and operates in a fixed phase rela-

[8] Snow ..... 2,067,353 ..... January 12, 1937

tionship with the first oscillator. The slave station also includes a frequency dividing circuit which is coupled to the second oscillator and provides the pulse modulation for the slave carrier. The pulses impressed on the slave carrier signal are identical to the master pulses except for a time delay introduced by the frequency dividing circuit of the slave station. The master and slave transmitting stations radiate synchronized pulses having synchronized carrier signals.

The defendant's Loran-C navigation system is a pulse transmission system in which synchronized pulses are radiated from master and slave transmitting stations. It is a characteristic of the pulses that the master and slave carrier frequencies forming the pulses are also synchronized. The oscillator of the slave station is not sucked in to the operation of the master oscillator. In the slave transmitting equipment of the Loran-C system, the signal from the slave oscillator is applied to an adjustable phase shifter and then to a phase difference detector. The detector is also connected to an antenna which receives the transmitted master signals. It determines the phase difference between the master carrier signal and the signal from the phase shifter and provides an output to adjust the phase shifter in order to bring the compared signals into synchronism. In determining whether defendant's Loran-C system infringes patent claims 6 and 7, it is also necessary to compare the structure operation, and result accomplished by the system and the patented invention. *Eastern Rotocraft Corp.* v. *United States*, *supra*; *Texsteam Corp.* v. *Blanchard*, *supra*. The ordinary test of patent infringement is whether the patented and accused systems operate in substantially the same way to accomplish the same result. *Nickerson* v. *Barefoot Sole Co.*, 311 F.2d 858, 859, 136 USPQ 96, 113 (6th Cir. 1962), as amended January

10, 1963, *cert. denied*, 375 U. S. 815, 139 USPQ 563 (1963). A comparison between Loran-C and the system of the '980 patent reveals a significant difference in the respective arrangements for accomplishing synchronization of the carrier signals. In the '980 patent a receiver responsive to the master carrier signal is directly connected to the slave oscillator to synchronize the slave carrier signal from the oscillator with the received master carrier signal. In Loran-C there is no direct connection of the receiver to the slave oscillator. An adjustable phase shifter is interposed between the oscillator and a phase detector which performs a phase comparison on signals derived from the phase shifter and from a receiver responsive to the master carrier signal and adjusts the phase shifter until synchronism is achieved. Defendant's Loran-C does not include a receiving device which operates in accordance with the language of claim 6 of the '980 patent. In Loran-C, the receiving device is not coupled to the slave oscillator and does not operate to synchronize the slave oscillator with the master oscillator. The arrangement of the Loran-C system is not equivalent to the invention of the '980 patent because the operations of the two systems is synchronizing the carrier signals are substantially different. Claim 6 of the '980 patent has not been infringed.

Patent claim 7 of '980 specifically calls for the radiation of pulse modulated carrier waves having the characteristics that each pulse contains less than 100 carrier wave cycles and that the time spacing between pulses is at least three times the duration of each pulse and an exact full number multiple of the duration of one carrier wave cycle. The evidence does not establish that the defendant's Loran-C system operates in a manner which corresponds to the operation defined in patent claim 7. There is no showing that Loran-C performs the same function in sub-

stantially the same way to accomplish substantially the same result as the patented invention. The explanation of the operation of the Loran-C system presented by plaintiff's expert testimony is insufficient to support a conclusion that the signals transmitted by the Loran-C stations have the characteristics expressed in claim 7 of the '980 patent. Patent claim 7 of '980 has not been infringed.

Defendant has also contended that the '980 patent discloses a system which has never been commercially manufactured or exploited and hence must be a *paper patent* which must be strictly and narrowly construed. In a close case, the fact that a paper patent is involved might be persuasive in finding that a patent claim is not infringed. Lack of present commercial success by a patent owner himself does not preclude enforcement of his right to exclude others. The record established no intention by the plaintiff not to use its inventions. Plaintiff has clearly shown that the combinations defined in claims 1, 2, and 3 of its '980 patent have been incorporated into a commercial Loran-C system and used. Thus, the evidence warrants the conclusion that the '980 patent is not a paper patent.

Patent 2,568,250

The '250 patent discloses a phase comparison circuit which provides a direct potential representative of the phase angle between two input signals applied to the circuit. The circuit includes a pair of rectifiers and a pair of equal resistances connected in series to rectifier terminals of opposite polarity. The input signals are applied to transformers, one of which has a secondary winding grounded at its midpoint, in order to supply the vector sum of the input signals to one of the rectifiers and the

vector difference of the signals to the other rectifier. The output signal at the midpoint of the resistances is proportional to the cosine of the phase angle between the input signals. Plaintiff relied upon claim 1 of the '250 patent. This patent claim reads as follows:

> [1] In a phase discriminator circuit for producing a direct control potential the magnitude of which is a function of the phase angle between a first and a second input signal of a given radio frequency, the combination of:
>
> (a) means for producing from one of said signals a third signal of said given frequency and bearing a fixed phase opposition relation to said second signal;
>
> (b) a pair of rectifiers;
>
> (c) circuit means for applying to one of said rectifiers the vector sum said first and second signals;
>
> (d) circuit means for applying to the other of said rectifiers the vector sum of said first and third signals;
>
> (e) and a pair of equal series connected resistances connected between said rectifiers, said resistances being connected to rectifier terminals of opposite polarity
>
> whereby the direct potential of the midpoint between said resistances is proportional to the cosine of the phase angle between said first and second input signals.

Defendant asserts that patent claim 1 of '250 is invalid under § 102(b) of Title 35 U.S.C. in view of the Purington patent and further asserts that this claim is invalid under

§ 102(e) in view of the Bell patent.[9] It is concluded that claim 1 of the '250 patent is invalid under § 102(b); hence defendant's contentions with respect to the question of validity under § 102(e) are not decided. It is also concluded that the evidence has not established that claim 1 is infringed by the defendant's Loran-C system.

In order that a reference anticipate an invention defined in a patent claim under § 102(b), the reference must disclose all the elements of the claimed combination, or their equivalents, functioning in substantially the same way to produce substantially the same results. *Palmer v. United States*, 182 Ct. Cl. 896, 900, 156 USPQ 689 (1968). *Strausser v. United States*, *supra*. Where the Patent Office considered the reference during the prosecution of the patent claim, there is a presumption that the claim is valid over the disclosure of that reference. The presumption of validity is a rebuttable presumption. Upon a clear showing that the reference considered by the Patent Office completely anticipates the patent claim, and that the distinctions argued by the applicant are not valid distinctions, the presumption is deemed to be rebuttal. *Palmer v. United States*, *supra*. The principles of the *Palmer* case are applicable to the question of patent validity with respect to claim 1 of the '250 patent. Defendant urges that this claim is anticipated, under § 102(b), by the Purington patent, a reference which was considered by the Patent Office during the prosecution of the patent claim. In urging the patentability of claim 1 over the Purington patent, the patent applicant argued that the reference did not suggest using a pair of equal resistances connected in series between rectifier terminals of opposite polarity. The applicant urged that no equivalent circuit was found in the Purington patent, and the Patent Office thereafter allowed

[9] Bell ..... 2,603,748 ..... July 15, 1952

the patent claim. A study of the Purington patent reveals that the disclosed phase comparison circuit includes an arrangement which is *equivalent* to the series connected resistances of patent claim 1. The Purington patent discloses a resistance connected through transformer windings to rectifier terminals of opposite polarity. The center point of the resistance provides a direct potential which indicates the difference in phase between input signals applied to the comparison circuit. The transformer windings of the circuit are arranged to apply the vector sum and the vector difference of the input signals to the rectifiers of the comparison circuit. The transformer windings disclosed in the Purington patent perform the same function as the transformers shown in the '250 patent and operate in substantially the same way to accomplish substantially the same result. It is concluded, under the principles of the *Palmer* case, *supra*, that the invention defined in claim 1 of the '250 patent is fully anticipated by the disclosure of the prior Purington patent and that claim 1 is invalid under § 102(b) of the patent statute. In view of this conclusion, no conclusion is made concerning the question of patent validity under § 102(e) of the statute.

Since claim 1 of the '250 patent is invalid, no conclusion is reached with respect to the issue of patent infringement of that claim. It is noted that plaintiff's evidence is not sufficient to establish that claim 1, if valid, has been infringed by the Loran-C system. Although Loran-C contains components corresponding to the elements set forth in the patent claim, it is not established that the Loran-C components perform the same function as the patented combination in substantially the same way to accomplish substantially the same result.

Summary

In summary, the following conclusions are made with respect to the issues of patent validity and infringement raised in this case:

(1) Claims 1-9, inclusive, of the '290 patent have not been infringed.

(2) Claim 3 of the '350 patent is invalid under Title 35 U.S.C. § 103;

(3) Claims 1, 2, and 3 of the '980 patent are valid and infringed;

(4) Claims 6 and 7 of the '980 patent have not been infringed;

(5) Claim 1 of the '250 patent is invalid under Title 35 U.S.C. § 102(b).

Plaintiff is entitled to recovery for infringement of claims 1, 2, and 3 of the '980 patent.

Findings of Fact

1. This is a patent suit arising under Title 28 U.S.C. § 1498 for reasonable and entire compensation for the unauthorized manufacture and use by or for the United States of the inventions set forth in U.S. Letters Patent Nos. 2,568,250, 2,578,980, 2,582,350, and 2,598,350. All of the patents were issued in the name of William J. O'Brien. The filing dates and issue dates of the patents are set forth below:

Patent No.	*Filing Date*	*Issue Date*	*Title of Patent*
2,568,250	March 29, 1948 ..	September 18, 1951 ..	Phase Comparitor Circuits.
2,578,980	February 2, 1948 ..	December 18, 1951 ..	Radio Frequency Navigation System.
2,582,350	October 7, 1946 ..	January 15, 1952 ..	Radio Beacon System.
2,598,290	August 27, 1945 ..	May 27, 1952 ..	Area Identification System.

Plaintiff specifically charges that the United States has infringed claim 1 of the '250 patent, claims 1, 2, 3, 6, and 7 of the '980 patent, claim 3 of the '350 patent, and claims 15-19, inclusive, of the '290 patent by using "Loran-C" navigation systems and having equipment manufactured for use in such systems.

2. Plaintiff, Decca Limited, is a British corporation domiciled in London, England, and is the record owner of the '250, '980, '350, and '290 patents. The following definitions of technical terms used in these findings and in the opinion may facilitate understanding the issues involved. Carrier frequency is the frequency of the signals radiated from a transmitting antenna and is expressed in kilocycles per second, hereinafter kc. A continuous wave (CW) signal is an uninterrupted alternating current signal having a single frequency and a wave form generally in the shape of a sine wave. A cycle is the time required for a continuous wave signal to pass from its maximum amplitude through its minimum amplitude and back to its maximum amplitude starting point for repeat. Modulation is the alteration of a carrier frequency signal obtained by impressing on or adding to the carrier signal another signal. Pulse modulation produces signals in the form of pulses spaced apart by fixed time intervals. Synchronization is controlling a first signal so that its characteristics are maintained in a fixed time relationship with the corresponding characteristics of a second signal.

3. This patent suit involves electronic aids to navigation of the type known as hyperbolic radio navigation systems. In the operation of a hyperbolic navigation system, a mobile receiver measures the time difference in arrival of radio signals radiated from separate fixed transmitting stations. This time difference constitutes a mea-

surement of the difference between the distances traveled by the radio signals from the transmitting stations to the receiver. By determining the difference in the distances between the separate transmitting stations and the receiver, a hyperbolic line of position is defined on which the receiver is located. If three separate transmitting stations are employed, then intersecting hyperbolic lines of position are defined and the intersections of these hyperbolic lines may be used to determine the position of the receiver relative to the transmitting stations. This type of navigation system is hyperbolic because the lines of position defined by the transmitting stations are in the form of hyperbolas. A hyperbola is defined as a curve formed by points located at a constant difference from two fixed points. The mobile receiver is designed to measure the relative times of arrival of the signals from the transmitting stations. It is, therefore, capable of measuring the difference in distances between the receiver and the transmitting stations and determining hyperbolic lines which represent positions located at constant differences in distances from the transmitting stations. The signals radiated from the transmitting stations are synchronized and may take the form of unmodulated continuous waves (CW), modulated continuous waves, or pulses.

4. In order to understand the arrangement and operation of the Loran-C system, it is helpful to consider a navigation system, Loran-A, which was developed prior to Loran-C. The Loran-A system is an electronic aid to navigation of the type known as a hyperbolic navigation system. The system employs radio frequency transmitters spaced apart by fixed distances to radiate signals in the form of pulses. The transmitters operate on transmitting frequencies in the range of 1,700 kilocycles per second (kc) to 2,000 kc. The pulses radiated from the transmitters are bursts

of radio frequency signals having a carrier frequency within the abovementioned range and a pulse duration of 50 microseconds. A first pulse transmitting device is located at a master station and radiates pulses at a precisely controlled repetition rate. A second pulse transmitting device, located at a slave station, receives the pulses radiated from the master station and, thereafter, radiates pulses at the same repetition rate, but at a fixed time interval after the reception of the master pulses at the slave station. By maintaining the fixed time interval between the master and slave pulses, the pulse transmitting device at the slave station is synchronized with the pulse transmitting device at the master station. In order to define intersecting hyperbolic coordinates, the Loran-A system utilizes two slave stations operating in conjunction with one master station. The master station transmits two sets of pulses at slightly different repetition rates. A first slave station responds to one set of pulses from the master station and transmits slave pulses at the same repetition rate and at a predetermined time interval after reception of the master pulses at the slave station. A second slave station responds to the other set of pulses from the master station and transmits slave pulses at the same repetition rate after interjecting a predetermined time delay into the received master pulses. The master and first slave stations define a first set of hyperbolic lines of position which are intersected by a second set of hyperbolic lines of position defined by the master and second slave stations. The Loran-A system employs a mobile receiver which responds to the pulses derived from the master and slave stations for measuring the time differences in arrival of pulses originating from the master and slave stations. Pulse matching is accomplished in the receiver by means of a display on a cathode ray oscilloscope. The sweep rate of the

oscilloscope is first synchronized with the repetition rate of the pulses received from the master station and the first slave station. The oscilloscope displays signals representative of the master and slave pulses and the spacing between the signals is a measure of the time difference in arrival of the pulses at the receiver. After measurement of this time difference, the oscilloscope sweep is synchronized to the repetition rate of the pulses from the master station and the second slave station. The time difference in arrival of these pulses at the receiver is also measured from a visual display of signals on the oscilloscope. This measurement of time differences defines intersecting hyperbolic lines of position which determine the position of the receiving in relation to the master and slave stations.

Patent 2,398,290

5. The '290 patent discloses an area identification system which employs modulated carrier signals radiated from spaced transmission points to identify the position of a mobile receiver relative to the fixed locations of the transmission points. The system of the '290 patent is a continuous wave system. In the system, three transmitters are utilized which operate on carrier frequencies of 60 kc, 80 kc and 90 kc, respectively. The master transmitter radiates a carrier frequency of 60 kc which is modulated at an audiofrequency of 2,400 cycles per second (cps). The modulated 60 kc signal is received at a first slave station which converts the received master signal to an 80 kc signal. This 80 kc signal is radiated from the slave station as the slave signal. Since the 60 kc signal received by the slave station is modulated at 2,400 cps, the 80 kc signal radiated from that station is also modulated at the same audiofrequency. Similarly, a second slave station receives the master signal (60 kc) and converts it to a 90 kc slave signal with an

audiomodulation of 2,400 cps. Both slave stations are equipped with phase discriminators and controllers for maintaining a fixed phase relation between the signals radiated from the slave stations and the signal from the master station. The master and slave signals are synchronized. The receiver employed in the '290 system is capable of receiving the 60 kc, 80 kc, and 90 kc signals simultaneously. The receiver is provided with frequency converters for converting the 60 kc signal to frequencies of 180 kc and 240 kc, for converting the 80 kc signal to a frequency of 240 kc, and for converting the 90 kc signal to a frequency of 180 kc. The 240 kc signals, derived from the 60 kc and 80 kc signals, are compared to indicate the phase difference between the 60 kc master signal and the 80 kc slave signal. In similar fashion, the 180 kc signals are compared to measure the phase difference between the 60 kc master signal and the 90 kc slave signal. The receiver is also designed to measure the phase difference of the 2,400 cps modulations impressed on the three carrier frequencies. By measuring the phase difference between the carrier signals radiated from the master and slave stations, the receiver is capable of determining lines of position along which master and slave signals are received at a constant phase difference. In the operation of the '290 system, a master and slave station define a plurality of hyperbolic lines of zero phase difference, *i.e.*, lines along which the receiver senses no phase difference between the carrier signals radiated from those stations. In the sector located between two adjacent lines of zero phase difference, the phase relation of the carrier signals varies progressively from zero degrees (0°) to 360°. Another slave station, operating in conjunction with the same master station, defines a second set of hyperbolic lines of zero phase difference which intersect the hyperbolic lines defined by the

master and the first slave station. The phase difference measurement of the modulation components of the master and slave stations determines the position of the receiver within a sector bounded by lines of zero phase difference. Measurement of the phase difference of the carrier components of the master and slave signals accurately determines the receiver position in the identified sector. By making phase difference measurement separately on the modulation and carrier components of the signals, the system of the '290 patent achieves coarse and fine determinations of the receiver position. Determination of the receiver position by phase comparison of the carrier components alone is ambiguous because this comparison determines the position of the receiver relative to two adjacent lines of zero phase difference but does not identify the two lines. Phase comparison of the modulation components resolves the ambiguity by determining the two lines of zero phase difference between which the receiver is located. The modulation frequency is chosen such that the spacing between a slave station and the master station is one wavelength of the modulation frequency. When phase comparison is performed on the modulation components, unique lines of constant phase difference are identified. These hyperbolic lines of constant phase difference provide a course coordinate system of lines from which unambiguous identification of receiver position is determined.

6. Claim 19 of the '290 patent, which is set forth in the opinion, defines a position determining system including (a) spaced transmitters for radiating waves having *carrier* and *modulation* components, (b) receiving means responsive to the *modulation* components for indicating the position of the receiving means in relation to at least one transmitter within a predetermined range, and (c) receiving means responsive to the *carrier* components for indicat-

ing the position of the receiving means within the predetermined range. Claims 15-18 of the '290 patent define a position determining system in substantially equivalent terms as claim 19.

7. Defendant has asserted that claim 19 of the '290 patent is invalid under Title 35 U.S.C. § 103 in view of the prior art available at the time the invention was made. In support of this assertion, defendant relies on the following prior art patents:

Patent No.	*Patentee*	*Date of Patent*
1,562,485 (U. S.)	H. A. Affel	November 24, 1925
546,000 (Germany)	Harms	March 8, 1932
2,144,203 (U. S.)	J. P. Shanklin	January 17, 1939

8. Affel patent, 1,562,485, discloses a position indicating system in which two fixed transmitting stations radiate signals having the same frequency. The signals radiated from the two fixed stations are derived from a common signal generator. A mobile station is provided with two unidirectional receiving antennas, each of which receives signals from only one of the fixed stations. A measuring device at the mobile station indicates the difference in phase between the signals received from the transmitting stations. The phase difference measurement is used to determine the speed of the moving station or the position of that station relative to moving the fixed stations. By counting the number of wavelengths traversed by the moving station, the total distance through which the station has moved is determined. The patent states that the general principle of this system is limited to the observation of movement relative to the line connecting the two fixed stations.

9. Shanklin patent, 2,144,203, discloses a position indicating system in which transmitters spaced apart by a fixed

distance radiate carrier signals having different fundamental frequencies. A modulation frequency having a wavelength directly proportional to the distance between the transmitters is impressed on the fundamental carrier frequencies radiated from the transmitters. The modulation frequencies are synchronized. A receiving station is equipped with two receivers tuned respectively to the signals radiated from the two transmitters. A phase meter located at the receiving station indicates the phase relation between the modulation components of the signals received from the transmitters. The modulation frequency is selected so that the spacing between the transmitters is equal to one-half the wavelength at that frequency. By phase comparison of the modulation components, the position of the receiver in relation to the transmitters is determined. In addition, this patent discloses that additional synchronized modulation frequencies may be impressed on the carrier signals to obtain greater accuracy in the determination of receiver position. These additional modulation components have frequencies which are multiples of the first modulation frequency impressed on the carrier signals.

The Shanklin patent discloses coarse position measurement at a low frequency and fine position measurement at a higher frequency. This Shanklin patent was cited by the Patent Office examiner during the prosecution of the application for the '290 patent.

10. Harms German patent 546,000 discloses a method of automatically determining the position of a movable receiver in which a pair of transmitters operating at related frequencies, *i.e.*, frequencies which can be transformed into one another, generate position fixing signals. These signals define hyperbolas of constant phase difference. In the

example presented in the German patent, one transmitter operates at a transmitting frequency which is twice the frequency of the other transmitter. The movable receiver is capable of receiving both of the transmitting frequencies. The receiver transforms the received signals to the same frequency and combines the transformed signals to provide an output indicative of the phase relationship of the received signals. This output operates a counting mechanism which automatically records the number of lines of zero phase difference over which the receiver has moved. In this manner the position of the receiver in relation to the transmitters is automatically recorded. This Harms German patent was cited by the Patent Office examiner during the prosecution of the application for the '290 patent.

11. It was established by expert testimony that the modulation frequency (2,400 cps) of the system disclosed in the '290 patent is impractical and that a higher frequency arrangement had to be developed in order to produce a system which is operative and acceptable. The 2,400 cps frequency is operable but not under conditions required for a commercial device. The size of the antenna required to radiate the transmitted signals determines whether or not the system is a practical proposition. The evidence of record shows that the frequencies of the system of the '290 patent could be employed in a navigation system within a small range, but, for a general navigation system, a higher modulation frequency is required. Plaintiff's evidence established that the system of the '290 patent has an operating range of 100 to 150 miles. The operating range of Loran-C is between 500 and 1,200 miles. The factor which accounts for the difference in the operating ranges of the systems is the effect of sky waves, *i.e.*, signals reflected from the ionosphere, on the operation of the systems. In

the system of the '290 patent, the signals originating from the transmitting stations cannot be distinguished from the sky waves. This results from the fact that arrangement of the '290 patent is a continuous wave system. In the Loran-C system, the signals originating from the transmitting stations are distinguishable from the sky waves, because the transmitted signals are in the form of pulses. The evidence indicates that audiomodulation of carrier frequencies was abandoned as an early experiment in the development of navigation systems by Decca because the operation of this type of system was not satisfactory at nighttime. There is evidence to indicate that Decca had not developed a satisfactory system for resolving lane ambiguity up to 1945 and that further development work was carried on to solve the problem of lane ambiguity.

42. In the prosecution of the patent application of the '290 patent, claims 15-49 of the '290 patent were copied from U. S. Patent No. 2,513,315, Hawkins, in order to provoke an interference between the '290 application and the Hawkins patent pursuant to Title 35 U.S.C. § 135(a). The application also attempted to copy a claim from the Hawkins patent which recited spaced transmitters for radiating modulated carrier waves having carrier components of different frequencies and modulation components of different frequencies. This proposed claim was rejected by the Patent Office because the '290 application did not disclose modulation components of different frequencies. In the opinion of the Patent Office, the '290 application disclosed only one component of audiofrequency and could not support a patent claim reciting modulation components of different frequencies. To pulse modulate a carrier wave, it would be necessary to transmit a large number of modulations of more than one frequency. A pulse system must

incorporate a large number of harmonically related sine wave modulation frequencies.

13. The accused Loran-C system is an electronic aid to navigation which was developed from the earlier Loran-A navigation system. It is a hyperbolic navigation system which combines the advantages of the pulse-matching and continuous-wave (CW) types of navigation systems. In the Loran-C system, the time difference in arrival of pulses radiated from master and slave transmitters is measured to determine the position of a receiver in relation to the transmitter positions, and the difference in phase of the carrier signals of the pulses is measured to more precisely define the position of the receiver. The determination of the receiver position in the Loran-C system involves both pulse-matching and cycle-matching measurements. The Loran-C system employs three transmitters, each of which operates on a transmitting frequency of 100 kc. A first transmitter is located at a master station and radiates pulses in the form of bursts of 100 kc signals at a predetermined repetition rate. A second transmitter, located at a slave station spaced from the master station, monitors the signal received from the master station. The second transmitter is provided with a 100 kc oscillator which is locked to the phase and frequency of the 100 kc signal received from the master station. From this 100 kc oscillator are derived the carrier frequency and the pulse recurrence interval required for transmission from the slave station. The slave transmitter inserts a prescribed coding delay into the signal transmitted from a slave station so that the slave transmitter radiates a pulse at a fixed time interval after the arrival of the pulse from the master station. A third transmitter, located at another slave station, operates in a manner similar to the operation of the second transmitter. The coding delay inserted by the third

transmitter is different, however, from the coding delay of the second transmitter. This difference in coding delays insures that a receiver located in the operating area of the system does not receive overlapping slave signals from the slave transmitters. The time-sharing or coding-delay technique of the Loran C navigation systems permits time difference measurement of pulse reception to be made by a single receiver. The receiver is provided with separate circuitry for determining the time difference in arrival of master and slave pulses and the phase difference between the radio frequency cycles which comprise the carrier signals for the pulses. In the measurement of the difference in arrival times of the master and slave pulses, the receiver generates sampling trigger signals which correspond to the received master and slave pulses. One of the trigger signals is synchronized with a predetermined sampling point on the master pulse, and the remaining trigger signals are synchronized with corresponding points on the slave pulses. The receiver is designed to provide direct readings of the amounts of time by which the trigger signals are shifted to align the trigger signals with the sampling points on the pulses. In this manner the receiver produces a direct measurement of the time difference in pulse reception and provides a coarse measurement of that time difference. The phase difference of the carrier frequency cycles from the master and slave transmitters is measured by synchronizing a 100 kc oscillator at the receiver with the carrier frequency cycles (100 kc) in the master pulse and then measuring the difference in phase between the signal from the reference oscillator and selected cycles in the pulse received from the slave transmitter. The receiver is also designed to provide a direct indication of this phase difference which provides a fine measurement of the time difference in arrival of the master and slave

pulses. The receiver of the accused Loran-C system is designed to perform its measurements on the leading edge of each received pulse, i.e., on that portion of the pulse which is not affected by sky waves. Patent claims 15-19, inclusive, of the '980 patent have not been infringed by the defendant's Loran-C equipment.

Patent 2,582,350

14. The '350 patent discloses a radio beacon system which may be employed as a navigation aid. In the system disclosed in the '350 patent, a pair of transmitters radiate synchronized signals to provide a hyperbolic pattern of lines of constant phase relation between the synchronized signals. A receiver responsive to the signals radiated from the transmitters measures the phase difference between the signals to identify the hyperbolic position line on which it is located. The transmitters radiate signals having different but harmonically related frequencies which are maintained in a fixed multiple phase relation. In the system disclosed in the '350 patent, one of the transmitters operates on a first frequency and the other transmitter operates on a second frequency which is twice the value of the first frequency. The frequencies are received by separate channels in the receiver which are provided with frequency multiplying circuits for converting the received signals to the same frequency. The '350 patent discloses, for example, that the receiver channel which responds to the first frequency may be provided with a frequency quadrupling circuit and the channel which responds to the second frequency with a frequency doubling circuit in order to convert the received signals to a common frequency. The receiver performs a phase comparison on the

[1] This number appears to be an obvious typographical error. It should be '501'.

converted signals to determine the phase relation of the received signals. In performing the phase comparison, the vector sum of the converted signals, *i.e.*, the signals having the common frequency, is applied to a first rectifier in the receiver. The vector difference of the signals is applied to a second rectifier. The rectifiers provide direct potentials which are compared to indicate the phase relation of transmitted signals at the position of the receiver.

15. Claim 3 of the '350 patent, which is set forth in the opinion and which is the claim upon which plaintiff relies to establish its allegation of patent infringement, defines a method of measuring the phase relation between two synchronized radio waves radiated from spaced locations. The claim recites the steps of: (a) separately receiving the waves, (b) amplifying the waves to provide two radio frequency signals, (c) adding the signals to provide a first alternating potential, (d) subtracting one signal from the other to provide a second alternating potential, (e) separately rectifying the alternating potentials, and (f) comparing the direct potentials to obtain a measurement of the desired phase relation.

16. Defendant has asserted that claim 3 of the '350 patent is invalid under Title 35 U. S. C. § 102 (b) and under Title 35 U. S. C. § 103. In support of these contentions, defendant has relied on the following prior patents:

Patent No.	*Patentee*	*Date of Patent*
1[illegible],248 (U. S.)	H. A. Affel	November 21, 1933
556,000 (German)	Harms	March 8, 1932
2,028,880 (U. S.)	W. Runge	January 28, 1936
2,144,203 (U. S.)	J. P. Shanklin	January 17, 1939

17. Defendant contends that claim 3 is anticipated under § 102 (b) by either the Affel patent or the Harms patent. In addition, defendant asserts that the claimed subject matter would have been obvious to one skilled in

the radio navigation art, under § 103 of the statute, by combining the Harms patent with either the Affel patent or the Runge patent. The disclosures of the Affel, Harms, and Shankline patents are set forth in the previous findings of fact 8-10. None of these four patents was made of record by the Patent Office examiner in the application file of the '350 patent.

18. Runge patent, 2,028,880, discloses an arrangement for synchronizing radio transmitters which incorporates a phase comparison circuit. The phase comparison circuit includes a pair of rectifier tubes. In comparing the phase of two signals, e_1 and e_2, one of the signals is divided into two equal and opposite voltages ($\frac{1}{2}e_1$ and $-\frac{1}{2}e_1$) which are separately applied to the rectifier tubes. The signal e_2 is directly applied to both of the rectifier tubes. Thus, the signal applied to one of the rectifiers is the vector sum ($e_2 + \frac{1}{2}e_1$) and the signal applied to the other rectifier is the vector difference ($e_2 - \frac{1}{2}e_1$) of two signals which are to be phase compared. The phase difference between the signals is determined by comparing the currents flowing through the rectifiers.

19. The evidence in the form of expert testimony and prior patents, 2,231,704 issued to Curtis and 2,281,995 issued to Purington, establishes that the method of phase comparison defined in claim 3 of the '350 patent, *i.e.*, the method of adding the signals to be phase compared, subtracting one of the signals from the other, separately rectifying the resulting signals, and comparing the direct potentials obtained from the step of rectification, merely describes the operation of phase discriminators which were known in the prior art. Claim 3 of the '350 patent is invalid under Title 35 U. S. C. § 103.

20. Plaintiff's exhibit MM, consisting of pages from the Sperry Manual designated as "SPN 28," illustrates equipment procured by defendant for use in Loran-C systems. The defendant agreed that this exhibit is representative of equipment procured by the Government, and that the Government purchased at least one piece of equipment, which utilized the circuits illustrated in the pages taken from the manual. The phase comparison circuit of the Loran-C receiver includes a pair of rectifiers. In the operation of the comparison circuit, the signals to be compared are combined so that the summation of the signals is applied to one of the rectifiers, and the difference between the signals is applied to the other rectifier. The rectifiers provide direct potentials from which an indication of the phase relation between the signals is obtained. In the operation of the Loran-C receiver, the pulse signals radiated from the transmitting stations are separately received at different intervals of time. The receiver employs a local reference oscillator, operating at a frequency of 100 kc, which is synchronized with the carrier frequency of the received master pulse. The signal generated by the reference oscillator and the carrier frequency of the received slave pulses are the signals applied to the phase comparison circuit of the receiver.

Patent 2,578,980

21. The '980 patent describes a radio frequency navigation system. The patent discloses a low frequency hyperbolic system in which the location of a receiver is determined by measuring the time difference in arrival of synchronized pulses transmitted from fixed transmitting stations. In the system of the '980 patent, the transmitting stations operate on the same carrier frequency (100 kc) and at the same pulse repetition rate. The carrier signals

radiated from the transmitting stations are maintained in a fixed phase relation and are pulse modulated at a rate of 50 pulses per second. The pulses occur at different time intervals so that a receiver is capable of identifying the transmitting stations corresponding to the pulses which it receives. The receiver measures the difference in the arrival times of the pulses to identify its position relative to the transmitting stations. In order to maintain the carrier signals in a fixed phase relation, one of the transmitting stations is operated as a master station and the remaining stations are operated as slaves. The transmitting equipment of the master station includes a stable crystal oscillator having an output frequency of 100 kc. The oscillator output is applied to a master antenna through a pulse modulator. The pulse modulator is operated by a frequency dividing circuit which has its input coupled to the oscillator output and its output coupled to the pulse modulator. Thus, the signals radiated from the master antenna have a carrier frequency of 100 kc which is pulse modulated at a rate determined by the frequency dividing circuit. The transmitting equipment of each slave station also includes a crystal oscillator operating at a frequency of 100 kc and a pulse modulator controlled by a frequency dividing circuit. The radiated slave signal has a carrier frequency of 100 kc and is pulse modulated at the same rate as the master signal. The slave transmitting equipment includes a phase regulating circuit for maintaining the slave carrier frequency in phase with the master carrier frequency. The phase regulating circuit includes a phase discriminator which monitors the 100 kc signal from the slave oscillator and the carrier frequency (100 kc) radiated from the antenna of the slave station. The phase discriminator compares the phase of the two 100 kc signals and provides an output potential which is representative of the phase

difference between the signals. The output potential is applied to an electronic phase regulator interposed between the slave oscillator and the pulse modulator.

The phase regulator provides a variable reactance which is controlled by the potential from the phase discriminator. The effect of the phase regulator is to shift the phase of its output relative to its input signal by an amount proportional to the magnitude of the control potential from the phase discriminator. The slave transmitting equipment also includes a receiving device responsive to the carrier frequency of the master station which is coupled to the slave oscillator. The receiving device operates to synchronize the slave oscillator with the oscillator at the master station. In this arrangement for synchronization, the slave oscillator is *sucked in*, *i.e.*, it operates in phase with the signals received from the master oscillator. The slave station also includes a phase adjuster in the pulse forming circuit to introduce a fixed time delay into the slave pulses relative to the received master pulses.

22. The receiver disclosed in the '980 patent includes a cathode ray oscilloscope for displaying the pulses received from the master and slave stations. The receiver is designed so that only one pulse may be displayed at a time. The pulse appears as a series of individual cycles of carrier frequency displayed on a spiral path on the oscilloscope. In measuring the time difference in arrival of master and slave pulses, the master pulse is first displayed on the oscilloscope and the third cycle of the pulse is visually aligned with a reference point on the spiral trace. Then the slave pulse is displayed on the spiral trace, and the distance along the spiral from the reference point to the third cycle of the slave pulse is measured to determine the time difference in arrival of the pulses.

23. Plaintiff's petition charged defendant with infringement of claims 1, 2, 3, 6, 8, and 9 of the '980 patent. Plaintiff later amended its petition to strike the allegations of infringement of claims 8 and 9. At trial, plaintiff presented evidence concerning the infringement of claim 7 of the '980 patent by defendant. Claim 1 of the '980 patent which is set forth in the opinion defines a radio navigation system which includes: (a) master and slave transmitters, (b) transmitting means at each station for radiating pulse modulated carrier waves, (c) receiving means at the slave station responsive to the radiations from the master station, (d) a phase discriminator at the slave station responsive to the phase relation between the carrier waves from the master and slave stations, and (e) a phase regulator operated by the phase discriminator for maintaining the carrier waves in a fixed phase relation. Claim 2 differs from claim 1 by adding means for delaying the radiation of each pulse from said slave station a fractional part of said pulse separation period. Claim 3 differs from claim 1 by adding a mobile receiving apparatus including means for receiving the radiations from said stations, and time measuring means actuated by said receiving means for measuring the difference in time between the reception of pulses from each of said stations.

24. Patent claim 6 of '980 recites a radio frequency navigation system including a first stable crystal oscillator and a frequency dividing phase shaping circuit at the master transmitter station and a second stable crystal oscillator and phase shaping circuit at the slave transmitter station. Patent claim 7 of '980 recites a radio navigation aid in which the number of carrier wave cycles in each pulse is less than 100 and in which the time spacing between pulses is at least three times the duration of each pulse.

25. Defendant has contended that claims 1, 2, and 3 of the '980 patent are invalid under Title 35 U.S.C. § 102 in view of LF Loran, a navigation system which was developed after the Loran-A system. Specifically, defendant asserts that LF Loran anticipates the invention set forth in these claims under §§ 102(a), 102(b), and 102(g) of the patent statute. LF Loran is a hyperbolic electronic navigation system in which transmitting stations radiate pulse modulated carrier waves. The transmitting stations operate on a common carrier frequency of 180 kc. The LF Loran system employs one master station and two slave stations. The pulse repetition rate of the signals from the master station is twice the repetition of the signals from the slave stations. In the operation of the system, the slave stations are locked to alternate pulses transmitted from the master station. In the LF Loran system, the pulses radiated from the master and slave stations are synchronized, and the carrier signals forming the master and slave pulses are also synchronized. The equipment of each slave station includes a crystal oscillator from which the carrier components and the pulse modulation of the slave pulses are derived. The crystal oscillator comprises an element of a timer used in the slave equipment to synchronize the transmitted slave signals with the master signals at the slave station. The timer includes an oscilloscope on which radio frequency signals corresponding to the carrier components of the master and slave pulses are displayed. The signals applied to the oscilloscope are derived from the slave oscillator and from a receiving antenna which responds to the master pulses. Synchronization of the slave station is accomplished by observing the signals on the oscilloscope and adjusting the phase and frequency of the slave oscillator so that the master and slave indications on the oscilloscope are superimposed. Thus, in the LF Loran

system, slave synchronization is performed manually by an operator located at the slave station who observes an oscilloscope display and adjusts the slave equipment until the slave signal is brought into coincidence with the master signal. The LF Loran system does not anticipate the invention defined in claims 1, 2, and 3 of the '980 patent.

26. Defendant has also contended that claims 1, 2, and 3 of the '980 patent are invalid under Title 35 U.S.C. § 103. In support of this defense, defendant has relied on the Runge patent identified in finding 16, and on the British O'Brien patent, 579,170, dated July 25, 1946. Defendant contends that the solution to the problem of maintaining two signals in a fixed phase relation, which is presented in the '980 patent, would have been obvious to a person having ordinary skill in the art in view of either the Runge patent or the British O'Brien patent. In addition, defendant contends that it would have been obvious to modify the LF Loran equipment in view of the disclosure of the Runge patent or the British O'Brien patent so that claims 1, 2, and 3 are invalid under § 103 of the patent statute. These contentions are without merit.

27. Runge patent, 2,028,880, was a reference of record in the prosecution of the application for the '980 patent. It discloses, as noted in finding 18, an arrangement for synchronizing the carrier frequencies radiated from separate radio transmitters. The system of the Runge patent includes a master station and a slave station. A signal derived from the carrier frequency of the master station is applied to a phase comparison device at the slave station over a cable extending from the master station to the slave station. A signal derived from the carrier frequency of the slave station is also applied to the phase comparison device. The device measures the difference in phase be-

tween the two signals and provides an output which controls the phase of the carrier frequency generated at the slave station to synchronize that carrier frequency with the master carrier frequency.

28. British O'Brien patent, 579,170, discloses a phase controlling circuit in a radio transmitter of a navigation system. The circuit contains a phase discriminator for performing a phase comparison and a phase regulator controlled by the phase discriminator for changing the phase of a signal radiated from an antenna in response to the phase difference detected by the phase discriminator. The effect of the phase controlling circuit is to prevent changes in the characteristics of the transmitting antenna from affecting the phase of the transmitted signal. The circuit compensates for any such changes and maintains the voltage applied to the antenna and the antenna current in a fixed phase relation.

29. Plaintiff has presented evidence tending to establish a date of invention in the United States for the subject matter of the '980 patent prior to February 2, 1948, the filing date of the '980 patent application. The evidence related to a meeting between the inventor and his U.S. patent attorney in 1945, and to the attorney's subsequent return to the United States. This evidence was intended to establish a date of invention earlier than the dates on which the prior art references cited by the defendant were available, in order to avoid the issues of patent claim validity under §§ 102 and 103 of the statute. In view of the conclusions reached herein on these validity issues, no determination is necessary on the sufficiency of plaintiff's evidence tending to establish an earlier date of invention.

30. R. L. Report 1064, defendant's exhibit 8, discloses the low frequency Loran system. Plaintiff and defendant

agreed that Report 1061 constituted a publication on October 10, 1947, the date on which the LF Loran Report was placed on sale by the United States Department of Commerce. No other conclusion is reached regarding the publication date of R. L. Reports in view of the conclusions concerning patent validity.

31. The Loran-C system described in findings 15 and 20, also includes transmitting equipment at the master and slave stations for generating pulses having the same carrier frequency, 100 kc. The pulses transmitted from the master and slave stations occur at the same repetition rate and have substantially the same time duration. The slave station of the Loran-C system includes a receiving antenna responsive to the signals transmitted from the master station and from the antenna of the slave station. The signal received from the master station is used to synchronize signals from a local oscillator with the master carrier frequency. The signal from the local oscillator is applied through an adjustable phase shifter to a phase coherent detector. The received signal is also applied to said detector which makes a phase comparison of the two signals. The phase coherent detector controls a cycle resolver which in turn regulates the phase of the carrier-frequency-transmitted slave signal to maintain the transmitted master and slave carrier frequencies in a fixed phase relation. The phase detector also controls the adjustable phase shifter to synchronize the signals from the local oscillator with the received master carrier signals.

32. Defendant has contended that the '980 patent is a paper patent in that the system of that patent has never been commercially made by the plaintiff. Although the system of the '980 patent has not been commercially exploited by the plaintiff, the '980 patent does provide a use

ful teaching of navigation principles which have been incorporated into the Loran-C system of navigation.

33. Defendant contends that claim 6 of the '980 patent is invalid because anticipated by the LF Loran system under Title 35 U.S.C. § 102. The LF Loran system is described in findings 25 and 30. Defendant further urges that this patent claim is invalid under Title 35 U.S.C. § 103 in view of United States Patent 2,967,258, issued to Snow in 1961. Snow patent, 2,967,258, discloses a radio transmitting system in which oscillators located at separate transmitting stations are synchronized with a frequency control source. The control source transmits a radio frequency signal which is received by antennas provided at each of the transmitting stations. The signals received by the antennas are applied to the respective oscillators in order to synchronize the oscillator signals with the received frequency control signals. Patent claim 6 of '980 has not been infringed by defendant's Loran-C.

34. Defendant contends that claim 7 of the '980 patent is invalid under Title 35 U.S.C. § 102 because anticipated by the LF Loran system. In addition, defendant asserts that the patent claim is invalid under § 103 of that title in view of the United States patents issued to Runge, Snow, and O'Brien, identified in findings 16, 33, and 26, respectively. Claim 7 of '980 is valid but has not been infringed by Loran-C.

35. The '250 patent discloses a phase comparator circuit which is useful in phase controlled radio frequency navigation systems. The circuit operates to provide a direct potential which is a function of the phase angle between two radio frequency input signals applied to the circuit. It includes a pair of rectifiers to which the vector sum and vector difference, respectively, of the input signals are

applied. A pair of resistances of equal magnitude are connected in series across the rectifiers to rectifier terminals of opposite polarity. By virtue of this arrangement, the potential which appears at the midpoint between the resistances is proportional to the cosine of the phase angle between the input signals.

Patent 2,568,250

36. In its petition, plaintiff alleged infringement of claims 1 and 2 of the '250 patent. At trial, plaintiff's evidence was directed to the question of infringement of claim 1. The only claim of the '250 patent which is here in issue is claim 1.

37. Claim 1 of the '250 patent, which is set forth in the opinion, defines a phase discriminator circuit for producing a direct potential having a magnitude which is proportional to the phase angle between first and second input signals. The claimed combination includes: (a) means for producing a third signal in phase opposition to one of the input signals; (b) a pair of rectifiers; (c) means for applying the vector sum of the first and second signals to one of the rectifiers; (d) means for applying the vector sum of the first and third signals to the other rectifiers; and (e) a pair of equal resistances connected in series across the rectifiers to rectifier terminals of opposite polarity to produce a direct potential at the midpoint between the resistances proportional to the cosine of the phase angle between the first and second input signals.

38. Defendant asserts that patent claim 1 of '250 is invalid under Title 35 U.S.C. § 102(b) in view of United States Patent No. 2,281,995 to Purington; that the claim is also invalid under Title 35 U.S.C. § 102(e) in view of

United States Patent No. 2,663,748 to Bell; and that infringement of claim 1 by Loran-C has not been established.

30. Purington patent, 2,281,995, discloses a phase comparison circuit in which the vector sum and the vector difference of two input signals are separately applied to two rectifiers. The input signals are applied to the rectifiers through transformers windings which are arranged to provide the vector sum to one of the rectifiers and the vector difference to the other rectifier. The magnitudes of the rectified voltages across the rectifiers determine the magnitude of a direct potential which appears at the center-point of a resistor connected to rectifier terminals of opposite polarity through the transformer windings. The direct potential is applied to a phase meter which indicates the difference in phase between the input signals to the comparison circuit. The Purington patent was considered by the Patent Office in the prosecution of claim 1 of the patent. Claim 1 was initially rejected by the Patent Office as unpatentable over the Purington patent. In the opinion of the patent examiner, the Purington reference disclosed a device having substantially the same structure and operating in the same way to produce the same result as the device defined in the patent claim. In response to the rejection, the patent applicant pointed out that the subject matter of the patent claim was not a broad invention and argued that the small differences between the claimed invention and the Purington patent provided the basis for a finding that the claimed invention was patentable. The applicant stressed that the Purington patent did not suggest the simplified arrangement of using a pair of equal series connected resistances between rectifier terminals of opposite polarity. After this argument was presented, the Patent Office eventually allowed the patent claim 1.

40. Bell patent, 2,603,748, discloses a frequency detector which is employed to detect variations in the frequency of an input signal from a predetermined value. The operation of the detector is similar to the operation of a conventional phase discriminator circuit. The detector includes a pair of rectifiers and a pair of equal resistances connected in series between rectifier terminals of opposite polarity. In the operation of the detector, voltages representing the vector sum and vector difference of voltages derived from an input signal are applied to the rectifiers. The midpoint between the resistances provides a direct potential output. The Bell patent is not concerned with the problem of measuring the difference in phase between two input signals to the detector circuit. The direct potential derived from the circuit is not a function of the phase angle between two input signals. The Bell patent was not cited by the Patent Office in the prosecution of the application for the '250 patent.

41. Plaintiff's evidence of patent infringement with respect to claim 1 of the '250 patent consists of a circuit diagram, plaintiff's Exhibit NN, representing equipment used in Loran-C, and testimony. Defendant stipulated that plaintiff's Exhibit NN represented equipment manufactured by the Sperry Company, at least one of which was procured by the Government for use in Loran-C. Loran-C does have circuit components which correspond to the language of the patent claim, but plaintiff's evidence concerning the operation of the Loran-C equipment was insufficient to warrant a finding that the operation thereof is substantially the same as the circuit operation set forth in claim 1 of the '250 patent. The evidence does not demonstrate that the Loran-C circuitry operates as a phase discriminator and produces a direct potential which repre-

sents the phase angle between two input signals which are compared. Claim 1 of the '250 patent has not been infringed by defendant's Loran-C.

Recommended Conclusion of Law

Upon the foregoing findings of fact which are made a part of the judgment herein, the court concludes as a matter of law that claims 1, 2, and 3 of patent 2,578,980 are valid and infringed; that claims 6 and 7 of said patent have not been infringed; that claims 15-19 inclusive, of patent 2,598,290 have not been infringed; that claim 3 of patent 2,582,350 is invalid; that claim 1 of patent 2,568,250 has not been infringed; that plaintiff is entitled to recover reasonable and entire compensation for the unauthorized use of the invention of the 2,578,980 patent in Loran-C by the defendant; and judgment is entered to that effect. The amount of recovery will be determined pursuant to Rule 47(c)(2).

Appendix B

IN THE UNITED STATES COURT OF CLAIMS

No. 274-64

(Decided January 23, 1970)

DECCA LIMITED v. THE UNITED STATES

Robert B. Russell, attorney of record, for plaintiff. *Henry C. Nields*, *Douglas E. Whitney* and *Russell & Nields*, of counsel.

Joseph A. Hill, with whom was *Assistant Attorney-General William D. Ruckelshaus*, for defendant.

Before COWEN, *Chief Judge*, LARAMORE, DURFEE, DAVIS, COLLINS, SKELTON, and NICHOLS, *Judges*.

OPINION

PER CURIAM:* This is a patent suit under Title 28 U.S.C. § 1498, in which plaintiff seeks to recover reasonable and entire compensation for the alleged unauthorized use by or for the defendant of inventions in the field of electronic aids to navigation as set forth in U.S. Letters Patent Nos. 2,598,290, 2,582,350, 2,578,980, and 2,568,250. Plaintiff is the owner of record of said patents. The liability issue,

* This opinion incorporates, with very minor changes, the opinion prepared by then Trial Commissioner Donald E. Lane (now Judge of the United States Court of Customs and Patent Appeals), except with respect to claims 1, 2, and 3 of Patent 2,578,980, as to which we differ from him in reasoning and result.

including patent infringement and patent validity issues, is before the court, and any accounting issues are deferred until the question of liability has been determined. Plaintiff alleges that patent claims 15-19, inclusive, of the '290 patent, claim 3 of the '350 patent, claims 1, 2, 3, 6, and 7 of the '980 patent, and claim 1 of the '250 patent have been infringed by the defendant's use of "Loran-C" navigation systems and the manufacture of equipment for use in said systems.

This litigation involves electronic apparatus for use in navigation, apparatus of the type known as hyperbolic radio navigation systems. In the operation of such systems, separate transmitting stations fixed at known locations radiate radio signals which are sensed by a mobile receiver located at a position remote from the transmitters. The transmitting stations are synchronized to radiate radio frequency signals in a fixed time relationship. The mobile receiver picks up the signals and measures the time difference on the signals from the separate transmitting stations. Such signals are usually in the radio frequency range of about 60 to 100 kilocycles per second. By measuring the time difference between signals received from a first pair of transmitting stations, the mobile receiver is capable of determining a first hyperbolic line of position on which the receiver is located. A hyperbolic line is a curved line formed by a series of points each located at a constant difference in distance from two fixed points, *i.e.*, from two fixed transmitting stations. The mobile receiver also measures the time difference between the signals received from a second pair of fixed transmitting stations and determines a second hyperbolic line of position. The intersection of the first and second lines of position pinpoints the current location of the mobile receiver relative to the several transmitting stations.

In one type of hyperbolic navigation system, the signals radiated from the transmitting stations are continuous wave signals, *i.e.*, signals in the form of sine or regular waives having a fixed frequency. In such a system, the time difference is determined by measuring the difference in the phase of the continuous wave signals received from the separate transmitting stations. In another type of hyperbolic navigation system, the signals are radiated in the form of pulses or bursts spaced apart by fixed time intervals. In this second system, the mobile receiver measures the time difference between the arrival of the pulses or bursts from the separate transmitters. In both types of systems, time difference measurements are made to determine the current position of the mobile receiver in relation to the known locations of the transmitting stations. The continuous wave (CW) system measures the difference in phase, whereas the pulse system measures the time difference directly, in order to ascertain the position of the receiver.

Patent 2,598,290

The '290 patent discloses an area identification system in which transmitting stations radiate modulated carrier signals. A radio frequency carrier signal is modulated by impressing another signal such as an audiofrequency signal on the carrier frequency signal to produce a regular alteration of the frequency or the amplitude of the frequency. Each of the carrier signals is modulated by the same modulation frequency, a signal in the form of a single sine wave. The mobile receiver performs two phase difference measurements. By measuring the difference in phase between the modulation components of the signals, the receiver provides a coarse indication of its location with respect to the fixed transmitting stations. By meas-

uring the phase difference between the carrier components of the signals, the receiver provides a fine indication of its location. At trial, plaintiff relied upon claim 19 of the '290 patent. This patent claim reads as follows:

> [19] In a position determining system,
>
> (a) spaced transmitters for radiating waves each comprising carrier and modulation components,
>
> (b) means at a receiving point responsive to the modulation components of said waves for providing an indication which represents within a predetermined range the position of said receiving point relative to at least one of said transmitters, and
>
> (c) means at said receiving point responsive to the carrier components of said waves for providing a second indication accurately representative of the position of said receiving point within said predetermined range,
>
> thereby accurately to define the position of said receiving point relative to said one transmitter.

The defenses asserted by the defendant include invalidity of the '290 patent under Title 35 U.S.C. § 103 in view of the prior art, invalidity of the '290 patent under Title 35 U.S.C. § 102(a) and § 102(g) as anticipated by low frequency Loran, invalidity of the '290 patent under Title 35 U.S.C. § 101, and noninfringement of the '290 patent by the Loran-C navigation system. It is concluded that the Loran-C system does not infringe claims 15-19 of the '290 patent. No conclusion is made regarding the other defenses raised by the defendant.

In determining the issue of patent infringement, it is well-settled law that in the first instance resort must be made to the language of the patent claim. *Graver Tank & Manufacturing Co. v. Linde Air Products Co.*, 339 U.S. 605

(1950). The literal words of the patent claim constitute, however, only the starting point in the determination of this issue. The state of the prior art and the prosecution history of the patent application in the Patent Office are also important factors which must be considered in determining the meaning of a patent claim. *Graham* v *John Deere Co.*, 383 U.S. 1, 17 (1966). Unless the patented invention is identical, in all respects, to the accused arrangement, the proper interpretation which is to be accorded to the language of the patent claim must be decided before the infringement issue can be resolved. Where a patented and accused device are not identical, it is necessary to consider the structure, operation, and result obtained by each device. *Machine Co.* v. *Murphy*, 97 U.S. 120, 125 (1877), sets forth the traditional principle of infringement: "if two devices do the same work in substantially the same way, and accomplish substantially the same result, they are the same, even though they differ in name, form, or shape." This principle is the basis for the doctrine of equivalents which is the standard for interpretation of language appearing in patent claims.

The doctrine of equivalents determines the scope of protection provided by patent claims which define the patent monopoly awarded to an inventor upon the issuance of his patent. This doctrine also establishes the limits on the protection available to a patent owner. Devices which are equivalents of the invention defined by a patent claim are encompassed within the claim. The claim cannot, however, be interpreted to encompass a device which is not the equivalent of the defined invention. The doctrine must be considered in every case in which the issue of patent infringement is involved. Literal infringement of a patent claim is not sufficient to establish liability for patent in-

fringement. A device may be so far changed in principle from a patented device that it performs the same or similar function in a substantially different way, even though it falls within the literal words of the claim. In this case, the doctrine of equivalents may be used to restrict the claim and defeat the patentee's action for infringement. *Westinghouse* v. *Boyden Power Brake Co.*, 170 U. S. 537, 568 (1898).

Claim 19 of the '290 patent defines a position determining system as a combination of elements in which two of the elements are set forth as means for performing desired functions. There is no recitation of any specific structure for performing those functions. In this situation, the structure disclosed in the specification of the patent must be considered, and the patent claim will be construed to cover the disclosed structure and equivalents of that structure. *Stearns* v. *Tinker & Rasor*, 252 F. 2d 589, 116 USPQ 222 (9th Cir. 1957).

The system disclosed in the '290 patent is a continuous wave system which employs a master transmitting station and two slave stations. The master station radiates a carrier frequency of 60 kilocycles per second (kc) which is modulated at an audiofrequency of 2,400 cycles per second (cps). The first slave station receives the modulated 60 kc signal from the master station and converts this signal to an 80 kc carrier frequency. The 80 kc carrier frequency is also modulated at an audiofrequency of 2,400 cps, and the modulated 80 kc signal is radiated from the first slave station. Similarly, the second slave station receives the modulated 60 kc signal and converts it to a 90 kc slave signal with an audiomodulation of 2,400 cps.

The mobile receiver employed in the system disclosed in the '290 patent receives the master and slave signals simul-

taneously. The receiver is provided with frequency converters for converting the 60 kc and 80 kc carrier frequencies to 240 kc signals and for converting the 60 kc and 90 kc carrier frequencies to 180 kc signals. The receiver performs a phase difference measurement on the 240 kc signals to provide an indication of the difference in phase between the 60 kc master signal and the 80 kc slave signal. It also measures the phase difference between the 180 kc signals to provide an indication of the difference in phase between the 60 kc master signal and the 90 kc slave signal. In addition, the receiver is designed to measure the phase differences between the 2,400 cps modulations impressed on the master and slave carrier frequencies.

In the operation of the system disclosed in the '290 patent, the carrier frequencies transmitted from the master station and the first slave station define a first set of hyperbolic lines of zero phase difference, *i e*., lines along which the receiver senses no phase difference between the carrier frequencies. In the sector between two adjacent lines of zero phase difference, the phase relation of the carrier frequencies varies from zero degrees (0°) to 360°. The carrier frequencies transmitted from the master and the second slave stations define a second set of hyperbolic lines of zero phase difference which intersect the lines of the first set.

The mobile receiver determines its position relative to the transmitting stations by identifying the intersections of the hyperbolic lines. A coarse determination of receiver position is made by measurement of the phase difference of the modulation components of the transmitted signals. This measurement on the modulation components determines the position of the receiver within a sector bounded by lines of zero phase difference which are established by

the carrier frequency components. A fine determination of receiver position is made by measurement of the phase difference of the carrier components to accurately identify the position of the receiver within the sector. In order to achieve accurate position determination, the measurement performed by the receiver on the modulation components must provide an unambiguous identification of the sector within which the receiver is located. The fine position determination is made in relation to adjacent hyperbolic lines of zero phase difference. It only becomes meaningful when the hyperbolic lines defining the sector are uniquely identified. To facilitate unique identification of the hyperbolic lines, the transmitting stations are arranged so that the slave stations are spaced from the master station by distances equal to one wavelength of the multiplation frequency. With this arrangement, the phase difference measurement of the modulation components permits the determination of a unique receiver position from which the hyperbolic lines bordering the sector of receiver position may be identified.

In construing the terminology of claim 19 of the '290 patent, it is noted that the patent specification discloses frequency converters and phase comparison circuitry in the receiver which correspond to the claim language "means at a receiving point responsive to the modulation components of said waves . . . ." Furthermore, the receiver includes additional phase comparison circuitry which corresponds to the language of the claim which recites "means at said receiving point responsive to the carrier components of said waves . . . ." The comparison circuitry in the receiver performs phase difference measurements on the carrier and modulation components of signals received by the receiver to determine the receiver position. The prior art pertinent

to the '290 patent is listed in finding 7 and shows that hyperbolic position determining systems were known at the time of the invention of the subject matter of the '290 patent. The Shanklin patent[1] discloses a position indicating system in which receiver position is determined by measuring the phase relation of modulation components of radio signals. The German Harms patent[2] discloses an unmodulated system wherein the receiver is responsive to carrier frequencies. In addition, the Shanklin patent indicates that a more accurate position determination may be obtained by impressing modulation frequencies which are multiples of the first modulation frequency on the carrier waves. Shanklin demonstrates the concept of course and fine position determination in a hyperbolic system but does not indicate the course position determination may be derived from the modulation components and fine position determination from the carrier components.

The prosecution history of the '290 patent shows that patent claim 19 was copied from an issued patent in order to provoke an interference between the '290 patent application and that patent. The Patent Office refused to allow the applicant to copy another claim from the patent which called for "modulation component of different frequencies * * *" because the '290 specification disclosed only one modulation frequency and could not support such a claim. Pursuant to the rejection of the claim by the Patent Office, applicant amended the claim to eliminate the recitation of different modulation frequencies, and the amended claim was then allowed. Although this claim is not relied upon to establish patent infringement, its prosecution history may be considered in determining the scope of the invention

[1] Shanklin ..... 2,144,203 ..... January 17, 1939
[2] Harms ..... German 546,000 ..... March 8, 1932

sought to be protected by the claims of the patent. *Graham v. John Deere*, *supra*. The prosecution history of the '290 patent indicates that the invention of the '290 patent contemplated a navigation system in which carrier signals were modulated at a single modulation frequency.

Loran-C Navigation System

Loran-C, the alleged infringing system, is a hyperbolic navigation system in which pulses are radiated from transmitting stations. The pulses are in the form of bursts of 100 kc carrier frequency signals. The transmitting stations are synchronized to radiate pulses at predetermined time intervals so that a mobile receiver responsive to the pulses does not detect any overlap in the received pulses. The receiver of the Loran-C system measures the time difference in arrival of pulses from the master and slave stations to provide a coarse indication of the receiver position relative to those stations. The receiver also measures the difference in phase between the carrier signals which form the pulses to provide a more precise determination of the position of the receiver. In order to measure the time difference between the received pulses, the receiver employs circuitry for generating sampling trigger signals which correspond to the received master and slave pulses. The trigger signals are aligned with predetermined sampling points on the master and slave pulses, and the receiver provides a direct indication of the amounts of time by which the trigger signals must be shifted to align the trigger signals with the sampling points on the pulses. The phase difference on the carrier frequencies is measured by synchronizing a 100 kc oscillator at the receiver with the carrier frequency (100 kc) of the received master pulse. The receiver circuitry then measures the difference in phase

between the signal from the reference oscillator and the carrier frequencies of the pulses received from the slave transmitters. The receiver provides a direct indication of this phase difference. The 100 kc reference oscillator is required because the Loran-C transmitting stations are synchronized so that no overlap in the transmitted pulses is detected by the receiver.

A comparison of Loran-C and the system of the '290 patent shows that both systems are concerned with hyperbolic navigation arrangements in which coarse position determination is derived from the modulation components of transmitted radio signals and fine position determination is derived from the carrier components of the signals. In Loran-C the carrier components have a frequency of 100 kc and the modulation components consist of the pulse repetition rate impressed on the 100 kc carriers. In the system of the '290 patent, the carrier components are 60 kc, 80 kc, and 90 kc, and the 2,400 cps signals impressed on the carriers are the modulation components. A difference between the system is that the system of the '290 patent employs modulation components in the form of continuous waves while Loran-C employs modulation components in the form of pulses. This difference accounts for a difference in the operating ranges of the two systems. The system of the '290 patent has an operating range of 100 to 150 miles, while Loran-C is capable of operating over a range of 500 to 1,200 miles. Because the '290 system radiates continuous wave signals, the signals radiated from the transmitting stations cannot be distinguished from the signals reflected from the ionosphere (sky waves) by a mobile receiver located at a distance from the transmitting stations. The effect of sky waves on the operation of the '290 system severely limits the distance over which the system is operative. The pulse transmission

employed in the Loran-C system allows the effect of sky waves on the system to be eliminated. The receiver of Loran-C bases its measurements on the leading edge of each received pulse. Since this portion of the pulse arrives at the receiver before any reflected signals (sky waves), the measurement is free of any sky wave interference. Thus, although the '290 system and Loran-C are concerned with similar objectives, the Loran-C system achieves substantially better results by employing pulse modulation to eliminate the effects of sky waves on the system operation.

Patent '290 Not Infringed by Loran-C

A detailed comparison of the components of Loran-C and the system of the '290 patent and the operation of the respective components shows that the two systems achieve hyperbolic navigation in substantially different ways. The plaintiff's charge of infringement is not supported in this instance. Although both systems employ modulation components in the determination of mobile receiver position, the pulse modulation of Loran-C is not equivalent to the continuous wave modulation taught by the '290 patent. Pulse modulation in Loran-C allows sky wave interference to be eliminated and requires that the receiver in the system operate in a manner completely different from the receiver operation in the '290 patent. The circuitry in the Loran-C receiver for generating sampling trigger signals and aligning the trigger signals with the received pulses operates on principles entirely different from the operation of the frequency converters and phase comparison circuitry disclosed in the '290 patent. In Loran-C, the fact that the pulses are received at different times requires that trigger circuitry be employed in the receiver to perform the time difference measurement on the pulses. In the system of the '290 patent, phase comparison circuitry is used because

the continuous wave signals are received simultaneously. To make a phase difference measurement on the carrier signals of the pulses, the Loran-C receiver must use a local reference oscillator because the carrier signals do not overlap at any time and phase difference measurement by direct comparison of the carrier signals is impossible. This is not true of the receiver of the '290 patent because the signals are received simultaneously.

Another difference between the two systems is in the manner in which unique identification of receiver position is achieved. In the '290 system, the transmitting stations are arranged so that the slave stations are spaced at equal distances from the master station by distances equal to the wavelength of the modulation frequency impressed on the carrier components. In the Loran-C system no special relationship between station spacing and pulse repetition rate is required.

In view of the differences between Loran-C and the '290 patent, it is concluded that defendant has not infringed claim 19 of the '290 patent by using Loran-C systems or by having equipment manufactured for use in Loran-C systems. The language of claims 15-18 of the '290 patent is substantially similar to that of claim 19, and it is further concluded that defendant has not infringed claims 15-18.

Patent 2,582,350

Plaintiff contends that defendant has infringed claim 3 of the '350 patent. This patent describes a radio navigation system in which synchronized radio signals of different but related frequencies are radiated from transmitting stations to provide a hyperbolic pattern of position lines along which the transmitted signals are in constant phase relation. The system employs a receiver responsive to the

transmitted signals to measure the phase difference between the signals to identify the hyperbolic position on which the receiver is located.

Claim 3 of the '350 patent defines a *method* of measuring the phase relation between two synchronized radio waves which is performed by the receiver disclosed in that patent. Patent claim 3 of the '350 patent reads as follows:

> [3] The method of measuring the phase relation between two synchronized radio waves radiated from spaced locations at a point remote from said locations which consists in
>
> (a) separately receiving each of said waves,
>
> (b) amplifying each of said received waves to provide two radio frequency signals,
>
> (c) adding said signals to provide one alternating potential of radio frequency,
>
> (d) subtracting one of said signals from the other to provide a second alternating potential of radio frequency,
>
> (e) separately rectifying said alternating potentials to provide corresponding direct potentials, and
>
> (f) comparing said direct potential,
>
> whereby a measurement of said phase relation is obtained.

The transmitting stations of the '350 patent radiate synchronized radio waves having different frequencies. The receiver is provided with channels for separately receiving the radio waves. The receiver channels include amplifying circuits for converting the received radio waves to signals of the same radio frequency. A phase comparison is performed on the derived signals by applying the sum of the signals to a first rectifier, by applying the difference between the signals to a second rectifier, and by comparing

the rectified potentials provided by the rectifiers to obtain a measurement of the phase relation of the signals.

The defenses asserted by the defendant with respect to the '350 patent are that patent claim 3 is invalid under Title 35 U.S.C. § 102(b), invalid under § 103, invalid because it recites the inherent operation of the apparatus disclosed in the patent, and that patent claim 3 has not been infringed. It is concluded that patent claim 3 of '350 is invalid under § 103, and that no conclusions need be made with respect to the other defenses raised by defendant.

Patent Claim 3 of '350 Invalid

In support of its defense that claim 3 is invalid, defendant has cited the patents to Affel[3] and Harms. The Affel patent discloses a position indicating system in which synchronized radio signals are radiated from spaced transmitting locations. The signals are synchronized by the common source of radio frequency energy used for the transmitting locations. The receiver disclosed in the Affel patent employs a pair of directional antennas for separately receiving the radio signals. The received signals are applied to amplifying devices which provide signals of constant amplitude. The signals from the amplifying devices are applied to the phase comparison circuitry of the receiver. The phase comparison circuitry disclosed in the Affel patent operates on the same principles of phase comparison set forth in the '350 patent. The arrangement of circuitry is such that the constant amplitude signals are combined by addition and subtraction, and the resultant sum and difference signals are applied to a balanced modulator which produces a direct current output corresponding to the relative phase of the input

[3] Affel ..... 1,562,485 ..... November 24, 1925

signals. The description of the phase comparison circuitry in the Affel patent is not sufficiently detailed to permit a conclusion that its operation is identical to the operation of the '350 patent system. The Affel patent does disclose a method of comparing the phase relation between two synchronized radio signals in which the signals are separately received and amplified to provide radio frequency signals on which a phase comparison is performed.

Defendant has also cited prior art patents to establish that the portion of claim 3 which describes the phase comparison method, *i.e.*, the steps of the claim beginning with "adding said signals . . .," was known in the art at the time that the invention of the '350 patent was made and, further, that these steps describe the principles of operation of any known phase comparison circuit. The Runge patent[4] discloses a phase comparison circuit in which the vector sum and difference of two signals to be phase compared are applied to rectifiers which provide direct current outputs. The rectifier outputs are compared to indicate the phase relation of the signals. The fact that the Runge patent discloses comparison of the rectifier currents while the '350 patent discloses a comparison of the potentials on the rectifiers is not significant. The Curtis[5] and Purington[6] patents both disclose phase comparison circuits which operate on the same principles as described in the operation of the '350 patent. In addition, both patents describe a comparison of rectifier potentials to obtain an indication of phase relation.

Title 35 U.S.C. § 103 provides that a patent may not be obtained if the subject matter as a whole would have been obvious, at the time the invention was made, to a person

[4] Runge ..... 2,028,880 ..... January 28, 1936
[5] Curtis ..... 2,231,704 ..... February 11, 1941
[6] Purington ..... 2,281,995 ..... May 5, 1942

having ordinary skill in the art to which said subject matter pertains. The Supreme Court stated in *Graham* v. *John Deere, supra,* that the issue of patent invalidity under § 103 lends itself to several basic factual inquiries including the scope and content of the prior art, differences between the prior art and the claim at issue, and the level of ordinary skill in the pertinent art. The prior art in this case shows that, in the art of radio navigation, it was known at the time the invention was made to measure the phase relation of synchronized radio waves by separately receiving the waves, amplifying the received waves, and performing a phase comparison measurement on the amplified waves. This is disclosed by the Affel patent which also suggest that the phase comparison may be performed by an arrangement similar to that described in the '350 patent. The Runge and Curtis patents disclose phase comparison circuits which operate in substantially the same manner as the method of phase comparison taught in the '350 patent and which circuits are utilized in the art of radio transmission. No evidence, other than the prior art patents and the expert testimony relating to the patents, has been presented to establish the actual level of ordinary skill existing in the art at the time the method of the '350 patent was disclosed.

Claim 3 of the '350 patent is invalid because, at the time of the invention, it would have been obvious to a person having ordinary skill in the radio navigation art to incorporate the phase comparison circuit of the Runge patent in the receiver of the Affel patent to obtain a device which would operate in accordance with the method of claim 3. The Affel patent suggests that a phase comparison circuit in which the signals to be phase compared are combined to produce summation and difference signals may be employed in a receiver in a radio navigation system. It

would have been within the exercise of ordinary skill in the art to substitute the phase comparator of the Runge patent for the corresponding circuitry of the Affel receiver. In view of the scope of the prior art, the differences between the prior art and the '350 patent, and the level of ordinary skill in the art as indicated by the prior art, it is concluded that claim 3 of the '350 patent is invalid under § 103 of the patent statute.

In view of invalidity under § 103, it is not necessary to reach a conclusion on the question of whether or not claim 3 is infringed by the Loran-C system. It is noted that the evidence presented by the plaintiff with respect to infringement is not sufficient to establish that claim 3 has been infringed. Plaintiff's evidence consisted of expert testimony relating to pages from a Government manual illustrating *circuits* in equipment procured by the Government. The expert testimony pointed out that the illustrated circuits contained elements corresponding to the language of the patent specification. The explanation of the circuits is insufficient to prove that circuit operation is substantially the same as the method set forth in claim 3 of the '350 patent.

Patent 2,578,980

Plaintiff contends that defendant has infringed claims 1, 2, 3, 6, and 7 of the '980 patent in using its Loran-C navigation system and in procuring the manufacture of equipment for use in that system. The system of the '980 patent is a hyperbolic navigation system in which receiver position is determined by measuring the time difference in arrival of synchronized pulses originating at fixed transmitting stations. The transmitting stations operate on a common carrier frequency of 100 kc. Pulse modulation at

identical repetition rates is impressed on the carrier frequencies. The durations of the pulses are uniform. An important aspect of the 980 system is synchronization. The pulses and the carrier frequencies of the transmitting stations are maintained in fixed time relationships. In order to accomplish synchronization, one of the fixed stations is operated as a master station and the remaining stations are operated as slaves. The slave stations are provided with devices for receiving the pulses transmitted from the master station. The receiving devices are connected to slave oscillators and said oscillators operate in synchronism with the carrier components of the received master pulses. The signals produced by the oscillators are pulse modulated at a fixed repetition rate and a predetermined time delay is inserted into the pulse modulation. The resulting pulses are applied to transmitting antennas at the slave stations. To maintain the slave oscillator output signals in synchronism with the slave antenna output signals, the transmitting equipment of each slave station is provided with phase regulating circuitry for controlling the phase of the carrier components of the slave pulses. This circuitry includes a phase discriminator, which performs a phase comparison, and a phase regulator operated by the phase discriminator. The phase discriminator measures the difference in phase between the carrier components of the slave pulses and the signal derived from the slave oscillator. Since the oscillator operates in synchronism with the carrier components of the master pulses, the phase discriminator, in effect, measures the phase difference in the carrier components of the master and slave pulses. The phase regulator adjusts the phase of the carrier components of the slave pulses in response to the phase measurement made by the discriminator to maintain the slave oscillator and slave antenna carrier components in a fixed phase relation.

In the system disclosed in the '980 patent, the mobile receiver includes a cathode ray oscilloscope which displays the master and slave pulses on a spiral trace. The time difference in arrival of the pulses at the receiver is determined by measuring the distance along the spiral trace which separates the master and slave pulses.

Patent claim 1 of the '980 patent defines a radio frequency navigation system and reads as follows:

> [1] In a radio frequency navigation system, the combination of:
>
> (a) a master and a slave transmitting station spaced from each other;
>
> (b) transmitting means at each of said stations for radiating therefrom carrier waves of like frequency pulse modulated at identical pulse recurrence rates and like pulse durations;
>
> (c) receiving means at said slave station for receiving the radiations from said master station;
>
> (d) a phase discriminator at said slave station coupled to the transmitting means thereat and to said receiving means responsive to the phase relation between the carrier waves radiated from said master and said slave stations;
>
> (e) and a phase regulator coupled to the transmitting means at said slave station and actuated by said phase discriminator for maintaining fixed the phase relation of said carrier waves.

Patent claim 2 of the '980 patent differs from claim 1 by adding:

> [f] and means for delaying the radiation of each pulse from said slave station a fractional part of said pulse separation period.

Patent claim 3 of the '980 patent differs from claim 1 by adding:

[f] and a mobile receiving apparatus including means for receiving the radiations from said stations,

[g] and time measuring means actuated by said receiving means for measuring the difference in time between the reception of pulses from each of said stations.

Patent Claims 1, 2, and 3 of '980 Invalid

Defendant contends that claims 1, 2, and 3 of the '980 patent are invalid under Title 35 U.S.C. § 102 or § 103. In support of its contentions, defendant relies on prior art patents and a report disclosing a navigation system known as LF Loran which was developed subsequent to the Loran-A system. It is concluded that the invention set forth in patent claims 1, 2, and 3 is obvious in view of the prior art.

We must note initially that claims 1, 2, and 3 of the '980 patent are so broad, by themselves, as to encompass *any* device accomplishing the general operation they describe. In fact, the claims would read precisely on an apparatus consisting of an LF Loran, with its master and slave stations, transmitting pulse-modulated signals, coupled to the British O'Brien patent, employing a phase discriminator-phase regulator. Since these are clearly "old", and plaintiff insists it has produced something novel, it is evident that a more detailed description is necessary to enable a reader to distinguish the '980 from other devices which might be covered by the '980 claims if they are read broadly and literally.

To prevent such invalidity of the patent for overbreadth and clear anticipation (35 U.S.C. § 112 (1964); *Hall v. Van Wormer*, 20 Wall. 353, 372 (1873); *see also Graver Tank & Mfg. Co. v. Linde Air Products Co.*, 336 U.S. 271,

276-77 (1949); *Special Equipment Co. v. Coe*, 324 U.S. 370, 385-86 (1945) (dissent); *General Electric Co. v. Wabash Appliance Corp.*, 304 U.S. 364, 368-72 (1938)), the specifications must in this instance be read to limit the claims. *Hailes v. Van Wormer*, 20 Wall. 353, 372 (1873); *Dominion Magnesium Ltd. v. United States*, 162 Ct. Cl. 249, 249-50, 320 F. 2d 388, 394 (1963). The painstaking detail of plaintiff's description indicates that the specifications reveal, not a mere example of his invention, but rather the precise nature of the claimed discovery. Thus, plaintiff's claim must be limited to what appears in the description. *Hailes v. Van Wormer*, *supra*, at 372. That is the way the patent is summarized *supra* under the heading "Patent 2,578,980".

Plaintiff has admitted in its briefs to the court, as it must, that the "sucked-in oscillator" principle and the phase discriminator-phase regulator described in the patent—the two principal components of the invention—are both old. [P's Reply Brief at 11-12]. Its argument for validity rests upon the novelty (*see, e.g., Atlantic & Pacific Tea Co. v. Supermarket Corp.*, 340 U.S. 147, 150, 152 (1950); *Expanded Metal Co. v. Bradford*, 214 U.S. 366, 381 (1909); *Brinkerhoff v. Hue*, 146 U.S. 515, 516 (1892); *Hailes v. Van Wormer*, 20 Wall. 353, 368 (1873)) and unobviousness (35 U.S.C. § 103 (1964)) of the combination of these two devices in a system using both pulses and continuous waves:

> [The '980] is a combined system in which both portions cooperatively and in sequence handle both pulses and CW [continuous waves], and as such it provides a pulse-CW synchronization combination which was not previously employed. [P's Reply Br. 12]

Plaintiff's alleged new, useful and unobvious contribution, flowing from the aggregation of these old elements is the instrument's adaptability to a combined pulse-cw system.

To achieve this combined pulse-cw synchronization, the specifications disclose two "separate" stages, one employing pulse signals and the other pulse signals converted to a continuous wave and back again through the use of a modulator. Summarily stated, the '980 device transmits pulse-type signals from the master to the slave station. These signals are received at the slave station and sent through an oscillator which is locked in or "sucked in" to the master oscillator, thereby maintaining an identical phase and frequency relationship between the two. The slave oscillator puts out a continuous sine wave, which is kept in phase by the phase discriminator phase-regulator with the carrier wave (also a continuous wave) upon which ride the pulse-modulated waves, constituting the slave antenna output. The phase-regulated continuous waves are then converted to pulse-modulated signals by means of a modulator, and transmitted from the slave antenna to the mobile receiving unit. Accepting *arguendo* that plaintiff has effected a new application of these two principles ("sucked-in" oscillator and phase-discriminator phase-regulator) through the '980 combination, the question remains, was the combination obvious in light of the prior art?

Considering the question of patent validity raised by the defendant under § 103 of the patent statute, the starting point is the inquiry prescribed by the Supreme Court in *Graham v. John Deere*, *supra*. The prior art in this instance consists mainly of the Runge patent, the British O'Brien patent,[7] and the LF Loran system. The Runge patent discloses an arrangement in which carrier signals radiated from separate master and slave transmitters are synchronized. Synchronization is automatically accom-

[7] O'Brien ..... British 579,370 ..... April 13, 1942

plished by a phase comparison device at a slave station which controls the phase of the signals radiated from the slave transmitter. The phase comparison device measures the difference in phase between the carrier signals of the slave transmitter and the carrier signals of the master transmitter. The signals from the master transmitter are applied to the phase comparison device by a cable extending between the master and slave stations. The arrangement of the Runge patent is limited to synchronization of continuous waves, and does not itself disclose any arrangement for synchronizing the carrier components of pulses transmitted from separate stations. The LF Loran employs manual synchronization between master and slave-station pulse-modulated signals through the use of an operator who observes the master and slave carrier signals on an oscilloscope and adjusts the slave oscillator until the master and slave signals appear in synchronism on the oscilloscope. The British O'Brien patent discloses a phase controlling circuit which contains a phase discriminator and a phase regulator controlled by the discriminator. It is specified in the British patent that the circuit may be employed in the radio transmitters of a navigation system in order to maintain the transmitters in a controlled phase relation. The circuit functions to maintain a fixed phase relation between the current flowing in a transmitting antenna and the voltage applied to the antenna. There is no suggestion in the British patent of the manner in which the phase controlling circuit might be incorporated into a pulse transmitting system to hold the carrier components of pulses radiated from separate transmitting stations in a fixed phase relation.

Defendant contends that the circuitry of the '980 patent for providing synchronization of the master and slave carrier signals would have been obvious to a person having

ordinary skill in this art. The use of master and slave stations is undoubtedly old. The idea of synchronizing the slave signal to the master is also concededly old. In the '980, this synchronization occurs, as already indicated, through two steps. The "sucked-in" oscillator in the slave receiver helps to synchronize the master pulses to the slave pulses, and the phase-discriminator phase-regulator operates on the slave signals at two different points to keep constant the phase between the signals at those points. Plaintiff does not deny that the idea of using a "sucked-in" oscillator for synchronization is old. As for the phase-discriminator phase-regulator, the British patent discloses a phase controlling circuit which maintains the output of a transmitting antenna in a fixed phase relation with respect to the input applied to that antenna. The circuit includes a phase discriminator and phase regulator combination which operates to maintain the signals appearing at separate points in the transmitting equipment in synchronism. Defendant asserts that this is precisely the function of the phase discriminator-phase regulator in the '980 patent.[3] Indeed, Mr. O'Brien himself has so testified [Record, at 249-52] and plaintiff so admits. On the basis of this analysis, defendant concludes that the solution to the problem of carrier synchronization presented in the '980 patent would have been obvious to a person of ordinary skill in the art within the meaning of § 103. We agree. While the British O'Brien patent (which deals only with continuous wave transmission) is not concerned with synchronizing carrier components of *pulses* radiated from separate transmitting stations, and does not suggest any manner in which a pulse-controlling circuit might be employed to accomplish synchronism in that situation, other

[3] It is important to note that the '980 phase discriminator-phase regulator operates solely upon continuous waves and not upon pulses—exactly as does the phase discriminator-phase regulator in the British patent.

prior art supplies a man of ordinary skill in the art with the automatic "sucked-in" oscillator principle which can be so employed. This is precisely what Mr. O'Brien did to create the '980, with a modulator to convert pulses to continuous waves, and vice versa, so that the phase-discriminator phase-regulator, as taken from the British patent, can operate in the context of a pulse system.

Judge Rich of the United States Court of Customs and Patent Appeals has set forth a colorful and useful guideline to be employed in Section 103 cases (*Application of Winslow*, 365 F. 2d 1017, 1020, 151 USPQ 48, 50-51 (CCPA 1966)):

> We think the proper way to apply the 103 obviousness test to a case like this is to first picture the inventor as working in his shop with the prior art references—*which he is presumed to know*—hanging on the walls around him * * * (emphasis added)
>
> * * * Section 103 requires us to presume full knowledge by the inventor of the *prior* art in the field of his endeavor.

In applying this standard to the case before us we see the following situation: A man of ordinary skill in the art of hyperbolic radio navigational systems is sitting at his desk, asking himself how he might construct a device employing the advantages of a pulse and also a continuous wave system, in combination, to achieve a better and more accurate radio-navigational system.[9] Looking on his wall, containing all prior art in the field, he sees the pulse-system LF Loran, sending pulse-modulated signals from a master and slave station, the Runge patent, and the other prior art with a "sucked-in" oscillator used to maintain a fixed-

[9] The use of continuous waves allows (through the phase discriminator-phase regulator) the correction of phase shift in the slave signal as it proceeds from the slave oscillator to the slave antenna—thereby helping to maintain the synchronization of master and slave signals.

phase relationship between master and slave stations. Next, there hangs Mr. O'Brien's British patent teaching observers the method of maintaining in phase carrier waves within the transmitting station (including a slave transmitter). The would-be inventor also knows, of course, of modulators which can turn pulses into continuous waves and back again. Considering the principles of each, we think that the man of ordinary skill in this area would certainly not find unobvious the idea of combining them, using a simple modulator to convert pulses into carrier waves and vice versa.

The general idea of pulse synchronization, the use of master and slave stations for pulse transmittals, the use of the oscillator to lock the master signal to that of the slave, would all be borrowed from the known art. The phase discriminator-phase regulator of the British patent would clearly show how synchronization would be increased if the pulses were transformed into continuous waves for a time. See notes 8-9, *supra*. An individual desiring thus to combine pulses with continuous waves, so as to strengthen synchronization, would certainly realize that the accepted and well-known way to convert a pulse into waves and waves into pulses would be through a modulator. That is what the '980 does. It takes the known devices of a "sucked-in" or locked in oscillator and a discriminator-regulator to perform the same functions as they performed in the prior art, and uses a modulator to transform the pulses into waves and vice versa, so that the phase-discriminator phase-regulator can operate. No component is new, and the whole combination, though it may have been new, was nevertheless obvious to one skilled in the art. See, for a comparable example in the mechanical field, *Ellicott Machine Corp.* v. *United States*, 186 Ct. Cl. 655, 667, 405 F. 2d 1385, 1391 (1969). *See, also, Anderson's-Black*

Rock, Inc. v. *Pavement Salvage Co.*, U.S. Sup. Ct., No. 45, decided Dec. 8, 1969.[10]

Patent Claims 6 and 7 of '980 Not Infringed

Patent claim 6 of '989 recites a radio frequency navigation system including a first stable crystal oscillator and a frequency dividing phase shaping circuit at the master transmitter station and a second stable crystal oscillator and phase shaping circuit at the slave transmitter station and need not be reproduced here in full text. Patent claim 7 of '980 recites a radio navigation aid in which the number of carrier wave cycles in each pulse is less than 100 and in which the time spacing between pulses is at least 3 times the duration of each pulse and also is not reproduced here in its full text.

In response to plaintiff's charge that claim 6 of the '980 patent has been infringed, defendant urges that claim 6 is invalid under Title 35 U.S.C. § 103 in view of the prior LF Loran system and that it is also invalid under § 102 in view of the prior Snow patent.[11] It is concluded that claim 6 of the '980 patent is not infringed by the Loran-C navigation system. In view of this conclusion, the contentions of the defendant with respect to invalidity need not be considered.

In determining the issue of patent infringement, the first step is to consider the specific language of the patent claim. *Dvorsky* v. *United States*, 173 Ct. Cl. 638, 352 F. 2d 373, 148 USPQ 87 (1965). The state of the prior art and the prose-

[10] We do not consider the contention (which plaintiff made before the trial commissioner) that the inventor of the '980 patent is entitled to an invention date prior to the filing date of the patent application since plaintiff did not renew that argument before the judges.

Also, in view of our holding of invalidity, it is unnecessary to consider whether defendant has infringed claims 1, 2, or 3 of the '980 patent.

[11] Snow ..... 2,067,535 ..... January 12, 1967

cution history should also be considered in interpreting that language. *Graham* v. *John Deere*, *supra*.—

Patent claim 6 of '980 relates to the synchronization of master and slave transmitting stations in a radio navigation system. This claim recites the two aspects of the synchronization employed in the '980 patent, *i.e.*, synchronization of the carrier signals radiated from the transmitting stations and synchronization of the pulse modulation impressed on the carrier signals. As the master transmitting station, a first crystal oscillator serves as the source of the master carrier signal and a frequency dividing circuit coupled to the oscillator provides the pulse modulation which is impressed on that signal. A second crystal oscillator at the slave transmitting station is the source of the slave carrier signal. A receiving device at the slave station responds to the carrier signal transmitted from the master station. The receiving device is coupled to the second oscillator and functions to maintain the second oscillator in synchronism with the first oscillator. In this arrangement, the second oscillator is "sucked in" and operates in a fixed phase relationship with the first oscillator. The slave station also includes a frequency dividing circuit which is coupled to the second oscillator and provides the pulse modulation for the slave carrier signal. The pulses impressed on the slave carrier signal are identical to the master pulses except for a time delay introduced by the frequency dividing circuit of the slave station. The master and slave transmitting stations radiate synchronized pulses having synchronized carrier signals.

The defendant's Loran-C navigation system is a pulse transmission system in which synchronized pulses are radiated from master and slave transmitting stations. It is a characteristic of the pulses that the master and slave

carrier frequencies forming the pulses are also synchonized. The oscillator of the slave station is not sucked in to the operation of the master oscillator. In the slave transmitting equipment of the Loran-C system, the signal from the slave oscillator is applied to an adjustable phase shifter and then to a phase difference detector. The detector is also connected to an antenna which receives the transmitted master signals. It determines the phase difference between the master carrier signal and the signal from the phase shifter and provides an output to adjust the phase shifter in order to bring the compared signals into synchronism. In determining whether defendant's Loran-C system infringes patent claims 6 and 7, it is also necessary to compare the structure, operation, and result accomplished by the system and the patented invention. *Eastern Rotorcraft Corp.* v. *United States*, 181 Ct. Cl. 299, 384 F. 2d 429, 155 USPQ 729 (1967); *Texsteam Corp.* v. *Blanchard*, 352 F. 2d 983, 147 USPQ 431 (5th Cir. 1965), *Cert. denied*, 387 U. S. 936 (1967). The ordinary test of patent infringement is whether the patented and accused systems operate in substantially the same way to accomplish the same result. *Nicherson* v. *Bearfoot Sole Co.*, 311 F. 2d 858, 859, 136 USPQ 96, 113 (6th Cir. 1962), as amended January 10, 1963, *cert. denied*, 375 U. S. 815, 139 USPQ 565 (1963). A comparison between Loran-C and the system of the '980 patent reveals a significant difference in the respective arrangements for accomplishing synchronization of the carrier signals. In the '980 patent a receiver responsive to the master carrier signal is directly connected to the slave oscillator to synchronize the slave carrier signal from the oscillator with the received master carrier signal. In Loran-C there is no direct connection of the receiver to the slave oscillator. An adjustable phase shifter is interposed between the oscillator and a phase

detector which performs a phase comparison on signals derived from the phase shifter and from a receiver responsive to the master carrier signal and adjusts the phase shifter until synchronism is achieved. Defendant's Loran-C does not include a receiving device which operates in accordance with the language of claim 6 of the '980 patent. In Loran-C, the receiving device is not coupled to the slave oscillator and does not operate to synchronize the slave oscillator with the master oscillator. The arrangement of the Loran-C system is not equivalent to the invention of the '980 patent because the operations of the two systems in synchronizing the carrier signals are substantially different. Claim 6 of the '980 patent has not been infringed.

Patent claim 7 of '980 specifically calls for the radiation of pulse modulated carrier waves having the characteristics that each pulse contains less than 100 carrier wave cycles and that the time spacing between pulses is at least three times the duration of each pulse and an exact full number multiple of the duration of one carrier wave cycle. The evidence does not establish that the defendant's Loran-C system operates in a manner which corresponds to the operation defined in patent claim 7. There is no showing that Loran-C performs the same function in substantially the same way to accomplish substantially the same result as the patented invention. The explanation of the operation of the Loran-C system presented by plaintiff's expert testimony is insufficient to support a conclusion that the signals transmitted by the Loran-C stations have the characteristics expressed in claim 7 of the '980 patent. Patent claim 7 of '980 has not been infringed.

Defendant has also contended that the '980 patent discloses a system which has never been commercially manu-

factured or exploited and hence must be a *paper patent* which must be strictly and narrowly construed. In a close case, the fact that a paper patent is involved might be persuasive in finding that a patent claim is not infringed. Lack of present commercial success by a patent owner himself does not preclude enforcement of his right to exclude others. The record established no intention by the plaintiff not to use its inventions. However, since we have decided the question of infringement adversely to the plaintiff, we need not decide defendant's contention with respect to paper patents.

Patent 2,568,250

The '250 patent discloses a phase comparison circuit which provides a direct potential representative of the phase angle between two input signals applied to the circuit. The circuit includes a pair of rectifiers and a pair of equal resistances connected in series to rectifier terminals of opposite polarity. The input signals are applied to transformers, one of which has a secondary winding grounded at its midpoint, in order to supply the vector sum of the input signals to one of the rectifiers and the vector difference of the signals to the other rectifier. The output signal at the midpoint of the resistances is proportional to the cosine of the phase angle between the input signals. Plaintiff relied upon claim 1 of the '250 patent. This patent claim reads as follows:

> [1] In a phase discriminator circuit for producing a direct control potential the magnitude of which is a function of the phase angle between a first and a second input signal of a given radio frequency, the combination of:
>
> (a) means for producing from one of said signals a third signal of said given frequency and bearing a

fixed phase opposition relation to said second signal;

(b) a pair of rectifiers;

(c) circuit means for applying to one of said rectifiers the vector sum of said first and second signals;

(d) circuit means for applying to the other of said rectifiers the vector sum of said first and third signals;

(e) and a pair of equal series connected resistances connected between said rectifiers, said resistances being connected to rectifier terminals of opposite polarity

whereby the direct potential of the midpoint between said resistances is proportional to the cosine of the phase angle between said first and second input signals.

Defendant asserts that patent claim 1 of '250 is invalid under § 102(b) of Title 35 U.S.C. in view of the Purington patent and further asserts that this claim is invalid under § 102(e) in view of the Bell patent.[12] It is concluded that claim 1 of the '250 patent is invalid under § 102(b); hence, defendant's contentions with respect to the question of validity under § 102(e) are not decided. It is also concluded that the evidence has not established that claim 1 is infringed by the defendant's Loran-C system.

In order that a reference anticipate an invention defined in a patent claim under § 102(b), the reference must disclose all the elements of the claimed combination, or their equivalents, functioning in substantially the same way to produce substantially the same results. *Palmer* v. *United States*, 182 Ct. Cl. 896, 900, 156 USPQ 689 (1968); *Strauss-ler* v. *United States*, 168 Ct. Cl. 852, 339 F. 2d 670, 143

[12] Bell ..... 2,603,748 ....., July 15, 1952

USPQ 443 (1964). Where the Patent Office considered the reference during the prosecution of the patent claim, there is a presumption that the claim is valid over the disclosure of that reference. The presumption of validity is a rebuttable presumption. Upon a clear showing that the reference considered by the Patent Office completely anticipates the patent claim, and that the distinctions argued by the applicant are not valid distinctions, the presumption is deemed to be rebutted. *Palmer v. United States*, *supra*. The principles of the *Palmer* case are applicable to the question of patent validity with respect to claim 1 of the '259 patent. Defendant urges that this claim is anticipated, under § 102(b), by the Purington patent, a reference which was considered by the Patent Office during the prosecution of the patent claim. In urging the patentability of claim 1 over the Purington patent, the patent applicant argued that the reference did not suggest using a pair of equal resistances connected in series between rectifier terminals of opposite polarity. The applicant urged that no equivalent circuit was found in the Purington patent, and the Patent Office thereafter allowed the patent claim. A study of the Purington patent reveals that the disclosed phase comparison circuit includes an arrangement which is *equivalent* to the series connected resistances of patent claim 1. The Purington patent discloses a resistance connected through transformer windings to rectifier terminals of opposite polarity. The center point of the resistance provides a direct potential which indicates the difference in phase between input signals applied to the comparison circuit. The transformer windings of the circuit are arranged to apply the vector sum and the vector difference of the input signals to the rectifiers of the comparison circuit. The transformer windings disclosed in the Purington patent perform the same function as the

transformers shown in the '250 patent and operate in substantially the same way to accomplish substantially the same result. It is concluded, under the principles of the *Palmer* case, *supra*, that the invention defined in claim 1 of the '250 patent is fully anticipated by the disclosure of the prior Purington patent and that claim 1 is invalid under § 102(b) of the patent statute. In view of this conclusion, no conclusion is made concerning the question of patent validity under § 102(e) of the statute.

Since claim 1 of the '250 patent is invalid, no conclusion is reached with respect to the issue of patent infringement of that claim. It is noted that plaintiff's evidence is not sufficient to establish that claim 1, if valid, has been infringed by the Loran-C system. Although Loran-C contains components corresponding to the elements set forth in the patent claim, it is not established that the Loran-C components perform the same function as the patented combination in substantially the same way to accomplish substantially the same result.

Summary

In summary, the following conclusions are made with respect to the issues of patent validity and infringement raised in this case:

(1) Claims 15-19, inclusive, of the '290 patent have not been infringed;

(2) Claim 3 of the '350 patent is invalid under Title 35 U.S.C. § 103;

(3) Claims 1, 2, and 3 of the '980 patent are invalid under Title 35 U.S.C. § 103;

(4) Claims 6 and 7 of the '980 patent have not been infringed;

(5) Claim 1 of the '250 patent is invalid under Title 35 U.S.C. § 102(b).

Plaintiff is not entitled to recover anything.

FINDINGS OF FACT

The court, having considered the evidence, the report of Trial Commissioner Donald E. Lane, and the briefs and arguments of counsel, makes findings of fact as follows:

1. This is a patent suit arising under Title 28 U.S.C. § 1498 for reasonable and entire compensation for the unauthorized manufacture and use by or for the United States of the inventions set forth in U.S. Letters Patent Nos. 2,568,250, 2,578,980, 2,582,350, and 2,598,350. All of the patents were issued in the name of William J. O'Brien. The filing dates and issue dates of the patents are set forth below:

Patent No.	*Filing Date*	*Issue Date*	*Title of Patent*
2,568,250	March 29, 1948	September 18, 1951	Phase Comparison Circuits.
2,578,980	February 2, 1948	December 18, 1951	Radio Frequency Navigation System.
2,582,350	October 7, 1946	January 15, 1952	Radio Beacon System
2,598,290	August 27, 1945	May 27, 1952	Area Identification System.

Plaintiff specifically charges that the United States has infringed claim 1 of the '250 patent, claims 1, 2, 3, 6, and 7 of the '980 patent, claim 3 of the '350 patent, and claims 15-19, inclusive, of the '290 patent by using "Loran-C" navigation systems and having equipment manufactured for use in such systems.

2. Plaintiff, Decca Limited, is a British corporation domiciled in London, England, and is the record owner of the '250, '980, '350, and '290 patents. The following definitions of technical terms used in these findings and in

the opinion may facilitate understanding the issues involved. Carrier frequency is the frequency of the signals radiated from a transmitting antenna and is expressed in kilocycles per second, hereinafter kc. A continuous wave (CW) signal is an uninterrupted alternating current signal having a single frequency and a wave form generally in the shape of a sine wave. A cycle is the time required for a continuous wave signal to pass from its maximum amplitude through its minimum amplitude and back to its maximum amplitude starting point for repeat. Modulation is the alteration of a carrier frequency signal obtained by impressing on or adding to the carrier signal another signal. Pulse modulation produces signals in the form of pulses spaced apart by fixed time intervals. Synchronization is controlling a first signal so that its characteristics are maintained in a fixed time relationship with the corresponding characteristics of a second signal.

3. This patent suit involves electronic aids to navigation of the type known as hyperbolic radio navigation systems. In the operation of a hyperbolic navigation system, a mobile receiver measures the time difference in arrival of radio signals radiated from separate fixed transmitting stations. This time difference constitutes a measurement of the difference between the distances traveled by the radio signals from the transmitting stations to the receiver. By determining the difference in the distances between the separate transmitting stations and the receiver, a hyperbolic line of position is defined on which the receiver is located. If three separate transmitting stations are employed, then intersecting hyperbolic lines of position are defined and the intersections of these hyperbolic lines may be used to determine the position of the receiver relative to the transmitting stations. This type of navigation system

is hyperbolic because the lines of position defined by the transmitting stations are in the form of hyperbolas. A hyperbola is defined as a curve formed by points located at a constant difference from two fixed points. The mobile receiver is designed to measure the relative times of arrival of the signals from the transmitting stations. It is, therefore, capable of measuring the difference in distances between the receiver and the transmitting stations and determining hyperbolic lines which represent positions located at constant differences in distances from the transmitting stations. The signals radiated from the transmitting stations are synchronized and may take the form of unmodulated continuous waves (CW), modulated continuous waves, or pulses.

4. In order to understand the arrangement and operation of the Loran-C system, it is helpful to consider a navigation system, Loran-A, which was developed prior to Loran-C. The Loran-A system is an electronic aid to navigation of the type known as a hyperbolic navigation system. The system employs radio frequency transmitters spaced apart by fixed distances to radiate signals in the form of pulses. The transmitters operate on transmitting frequencies in the range of 1,700 kilocycles per second (kc) to 2,000 kc. The pulses radiated from the transmitters are bursts of radio frequency signals having a carrier frequency within the above-mentioned range and a pulse duration of 50 microseconds. A first pulse transmitting device is located at a master station and radiates pulses at a precisely controlled repetition rate. A second pulse transmitting device, located at a slave station, receives the pulses radiated from the master station and, thereafter, radiates pulses at the same repetition rate, but at a fixed time interval after the reception of the master pulses at the slave

station. By maintaining the fixed time interval between the master and slave pulses, the pulse transmitting device at the slave station is synchronized with the pulse transmitting device at the master station. In order to define intersecting hyperbolic coordinates, the Loran-A system utilizes two slave stations operating in conjunction with one master station. The master station transmits two sets of pulses at slightly different repetition rates. A first slave station responds to one set of pulses from the master station and transmits slave pulses at the same repetition rate and at a predetermined time interval after reception of the master pulses at the slave station. A second slave station responds to the other set of pulses from the master station and transmits slave pulses at the same repetition rate after interjecting a predetermined time delay into the received master pulses. The master and first slave stations define a first set of hyperbolic lines of position which are intersected by a second set of hyperbolic lines of position defined by the master and second slave stations. The Loran-A system employs a mobile receiver which responds to the pulses derived from the master and slave stations for measuring the time differences in arrival of pulses originating from the master and slave stations. Pulse matching is accomplished in the receiver by means of a display on a cathode ray oscilloscope. The sweep rate of the oscilloscope is first synchronized with the repetition rate of the pulses received from the master station and the first slave station. The oscilloscope displays signals representative of the master and slave pulses and the spacing between the signals is a measure of the time differences in arrival of the pulses at the receiver. After measurement of this time difference, the oscilloscope sweep is synchronized to the repetition rate of the pulses from the master station and the second

identified sector. By making phase difference measurement separately on the modulation and carrier components of the signals, the system of the '290 patent achieves coarse and fine determinations of the receiver position. Determination of the receiver position by phase comparison of the carrier components alone is ambiguous because this comparison determines the position of the receiver relative to two adjacent lines of zero phase difference but does not identify the two lines. Phase comparison of the modulation components resolves the ambiguity by determining the two lines of zero phase difference between which the receiver is located. The modulation frequency is chosen such that the spacing between a slave station and the master station is one wavelength of the modulation frequency. When phase comparison is performed on the modulation components, unique lines of constant phase difference are identified. The hyperbolic lines of constant phase difference provide a coarse coordinate system of lines from which an unambiguous identification of receiver position is determined.

6. Claim 19 of the '290 patent, which is set forth in the opinion, defines a position determining system including (a) spaced transmitters for radiating waves having *carrier* and *modulation* components, (b) receiving means responsive to the *modulation* components for indicating the position of the receiving means in relation to at least one transmitter within a predetermined range, and (c) receiving means responsive to the *carrier* components for indicating the position of the receiving means within the predetermined range. Claims 15—18 of the '290 patent define a position determining system in substantially equivalent terms as claim 19.

7. Defendant has asserted that claim 19 of the '290 patent is invalid under Title 35 U. S. C. § 103 in view of the prior art available at the time the invention was made. In support of this assertion, defendant relies on the following prior art patents:

Patent No.	*Patentee*	*Date of Patent*
1,562,485 (U. S.)	H. A. Affel	November 24, 1925
546,000 (Germany)	Harms	March 8, 1932
2,144,203 (U. S.)	J. P. Shanklin	January 17, 1939

8. Affel patent, 1,562,485, discloses a position indicating system in which two fixed transmitting stations radiate signals having the same frequency. The signals radiated from the two fixed stations are derived from a common signal generator. A mobile station is provided with two unidirectional receiving antennas, each of which receives signals from only one of the fixed stations. A measuring device at the mobile station indicates the difference in phase between the signals received from the transmitting stations. The phase difference measurement is used to determine the speed of the moving station or the position of that station relative to moving the fixed stations. By counting the number of wavelengths traversed by the moving station, the total distance through which the station has moved is determined. The patent states that the general principle of this system is limited to the observation of movement relative to the line connecting the two fixed stations.

9. Shanklin patent, 2,144,203, discloses a position indicating system in which transmitters spaced apart by a fixed distance radiate carrier signals having different fundamental frequencies. A modulation frequency having a wavelength directly proportional to the distance between the transmitters is impressed on the fundamental carrier frequencies radiated from the transmitters. The modula-

tion frequencies are synchronized. A receiving station is equipped with two receivers tuned respectively to the signals radiated from the two transmitters. A phase meter located at the receiving station indicates the phase relation between the modulation components of the signals received from the transmitters. The modulation frequency is selected so that the spacing between the transmitters is equal to one-half the wavelength at that frequency. By phase comparison of the modulation components, the position of the receiver in relation to the transmitters is determined. In addition, this patent discloses that additional synchronized modulation frequencies may be impressed on the carrier signals to obtain greater accuracy in the determination of receiver position. These additional modulation components have frequencies which are multiples of the first modulation frequency impressed on the carrier signals.

The Shanklin patent discloses coarse position measurement at a low frequency and fine position measurement at a higher frequency. This Shanklin patent was cited by the Patent Office examiner during the prosecution of the application for the '290 patent.

10. Harms German patent 546,000 discloses a method of automatically determining the position of a moveable receiver in which a pair of transmitters operating at related frequencies, *i.e.*, frequencies which can be transformed into one another, generate position fixing signals. These signals define hyperbolas of constant phase difference. In the example presented in the German patent, one transmitter operates at a transmitting frequency which is twice the frequency of the other transmitter. The movable receiver is capable of receiving both of the transmitting frequencies. The receiver transforms the received signals to the same

frequency and combines the transformed signals to provide an output indicative of the phase relationship of the received signals. This output operates a counting mechanism which automatically records the number of lines of zero phase difference over which the receiver has moved. In this manner the position of the receiver in relation to the transmitters is automatically recorded. This Harms German patent was cited by the Patent Office examiner during the prosecution of the application for the '290 patent.

11. It was established by expert testimony that the modulation frequency (2,400 cps) of the system disclosed in the '290 patent is impractical and that a higher frequency arrangement had to be developed in order to produce a system which is operative and acceptable. The 2,400 cps frequency is operable but not under conditions required for a commercial device. The size of the antenna required to radiate the transmitted signals determines whether or not the system is a practical proposition. The evidence of record shows that the frequencies of the system of the '290 patent could be employed in a navigation system within a small range, but, for a general navigation system, a higher modulation frequency is required. Plaintiff's evidence established that the system of the '290 patent has an operating range of 100 to 150 miles. The operating range of Loran-C is between 500 and 1,200 miles. The factor which accounts for the difference in the operating ranges of the systems is the effect of sky waves, *i.e.*, signals reflected from the ionosphere, on the operation of the systems. In the system of the '290 patent, the signals originating from the transmitting stations cannot be distinguished from the sky waves. This results from the fact that arrangement of the '290 patent is a continuous wave system. In the Loran-C system, the signals originating from the transmitting

stations are distinguishable from the sky waves, because the transmitted signals are in the form of pulses. The evidence indicates that audiomodulation of carrier frequencies was abandoned as an early experiment in the development of navigation systems by Decca because the operation of this type of system was not satisfactory at nighttime. There is evidence to indicate that Decca had not developed a satisfactory system for resolving lane ambiguity up to 1945 and that further development work was carried on to solve the problem of lane-ambiguity.

12. In the prosecution of the patent application of the '290 patent, claims 15—19 of the '290 patent were copied from U. S. Patent No. 2,513,315, Hawkins, in order to provoke an interference between the '290 application and the Hawkins patent pursuant to Title 35 U. S. C. § 135(a). The applicant also attempted to copy a claim from the Hawkins patent which recited spaced transmitters for radiating modulated carrier waves having carrier components of different frequencies and modulation components of different frequencies. This proposed claim was rejected by the Patent Office because the '290 application did not disclose modulation components of different frequencies. In the opinion of the Patent Office, the '290 application disclosed only one component of audio-frequency and could not support a patent claim reciting modulation components of different frequencies. To pulse modulate a carrier wave, it would be necessary to transmit a large number of modulations of more than one frequency. A pulse system must incorporate a large number of harmonically related sine wave modulation frequencies.

13. The accused Loran-C system is an electronic aid to navigation which was developed from the earlier Loran-A navigation system. It is a hyperbolic navigation system

which combines the advantages of the pulse-matching and continuous-wave (CW) types of navigation systems. In the Loran-C system, the time difference in arrival of pulses radiated from master and slave transmitters is measured to determine the position of a receiver in relation to the transmitter positions, and the difference in phase of the carrier signals of the pulses is measured to more precisely define the position of the receiver. The determination of the receiver position in the Loran-C system involves both pulse-matching and cycle-matching measurements. The Loran-C system employs three transmitters, each of which operates on a transmitting frequency of 100 kc. A first transmitter is located at a master station and radiates pulses in the form of bursts of 100 kc signals at a predetermined repetition rate. A second transmitter, located at a slave station spaced from the master station, monitors the signal received from the master station. The second transmitter is provided with a 100 kc oscillator which is locked to the phase and frequency of the 100 kc signal received from the master station. From this 100 kc oscillator are derived the carrier frequency and the pulse recurrence interval required for transmission from the slave station. The slave transmitter inserts a prescribed coding delay into the signal transmitted from the slave station so that the slave transmitter radiates a pulse at a fixed time interval after the arrival of the pulse from the master station. A third transmitter, located at another slave station, operates in a manner similar to the operation of the second transmitter. The coding delay inserted by the third transmitter is different, however, from the coding delay of the second transmitter. This difference in coding delays insures that a receiver located in the operating area of the system does not receive overlapping slave signals from the slave transmitters. The time-sharing or coding-delay technique of

the Loran-C navigation system permits time difference measurement of pulse reception to be made by a single receiver. The receiver is provided with separate circuitry for determining the time difference in arrival of master and slave pulses and the phase difference between the radio frequency cycles which comprise the carrier signals for the pulses. In the measurement of the difference in arrival times of the master and slave pulses, the receiver generates sampling trigger signals which correspond to the received master and slave pulses. One of the trigger signals is synchronized with a predetermined sampling point on the master pulse, and the remaining trigger signals are synchronized with corresponding points on the slave pulses. The receiver is designed to provide direct readings of the amounts of time by which the trigger signals are shifted to align the trigger signals with the sampling points on the pulses. In this manner the receiver produces a direct measurement of the time difference in pulse reception and provides a coarse measurement of that time difference. The phase difference of the carrier frequency cycles from the master and slave transmitters is measured by synchronizing a 100 kc oscillator at the receiver with the carrier frequency cycles (100 kc) in the master pulse and then measuring the difference in phase between the signal from the reference oscillator and selected cycles in the pulse received from the slave transmitter. The receiver is also designed to provide a direct indication of this phase difference which provides a fine measurement of the time difference in arrival of the master and slave pulses. The receiver of the accused Loran-C system is designed to perform its measurements on the leading edge of each received pulse, *i.e.*, on that portion of the pulse which is not affected by sky waves. Patent claims 15—19, inclusive, of the '980

patent have not been infringed by the defendant's Loran-C equipment.

Patent 2,582,350

14. The '350 patent discloses a radio beacon system which may be employed as a navigation aid. In the system disclosed in the '350 patent, a pair of transmitters radiate synchronized signals to provide a hyperbolic pattern of lines of constant phase relation between the synchronized signals. A receiver responsive to the signals radiated from the transmitters measures the phase difference between the signals to identify the hyperbolic position line on which it is located. The transmitters radiate signals having different but harmonically related frequencies which are maintained in a fixed multiple phase relation. In the system disclosed in the '350 patent, one of the transmitters operates on a first frequency and the other transmitter operates on a second frequency which is twice the value of the first frequency. The frequencies are received by separate channels in the receiver which are provided with frequency multiplying circuits for converting the received signals to the same frequency. The '350 patent discloses, for example, that the receiver channel which responds to the first frequency may be provided with a frequency quadrupling circuit and the channel which responds to the second frequency, with a frequency doubling circuit in order to convert the received signals to a common frequency. The receiver performs a phase comparison on the converted signals to determine the phase relation of the received signals. In performing the phase comparison, the vector sum of the converted signals, *i.e.*, the signals having the common frequency is applied to a first rectifier in the receiver. The vector difference of the signals is applied to a second recti-

fier. The rectifiers provide direct potentials which are compared to indicate the phase relation of transmitted signals at the position of the receiver.

15. Claim 3 of the '350 patent, which is set forth in the opinion and which is the claim upon which plaintiff relies to establish its allegation of patent infringement, defines a method of measuring the phase relation between two synchronized radio waves radiated from spaced locations. The claim recites the steps of: (a) separately receiving the waves, (b) amplifying the waves to provide two radio frequency signals, (c) adding the signals to provide a first alternating potential, (d) subtracting one signal from the other to provide a second alternating potential, (e) separately rectifying the alternating potentials, and (f) comparing the direct potentials to obtain a measurement of the desired phase relation.

16. Defendant has asserted that claim 3 of the '350 patent is invalid under Title 35 U.S.C. § 102 (b) and under Title 35 U.S.C. § 103. In support of these contentions, defendant has relied on the following prior patents:

Patent No.	*Patentee*	*Date of Patent*
1,562,485 (U. S.)	H. A. Affel	November 24, 1925
546,000 (German)	Harms	March 8, 1932
2,028,880 (U. S.)	W. Runge	January 28, 1936
2,144,203 (U. S.)	J. P. Shanklin	January 17, 1939

17. Defendant contends that claim 3 is anticipated under § 102(b) by either the Affel patent or the Harms patent. In addition, defendant asserts that the claimed subject matter would have been obvious to one skilled in the radio navigation art, under § 103 of the statute, by combining the Harms patent with either the Affel patent or the Runge patent. The disclosures of the Affel, Harms, and Shanklin patents are set forth in the previous findings of fact 8-10. None of these four patents was made of

record by the Patent Office examiner in the application file of the '350 patent.

18. Runge patent, 2,028,880, discloses an arrangement for synchronizing radio transmitters which incorporates a phase comparison circuit. The phase comparison circuit includes a pair of rectifier tubes. In comparing the phase of two signals, e_1 and e_2, one of the signals is divided into two equal and opposite voltages ($\frac{1}{2}e_1$ and $-\frac{1}{2}e_1$), which are separately applied to the rectifier tubes. The signal e_2 is directly applied to both of the rectifier tubes. Thus, the signal applied to one of the rectifiers is the vector sum ($e_2 + \frac{1}{2}e_1$) and the signal applied to the other rectifier is the vector difference ($e_2 - \frac{1}{2}e_1$) of two signals which are to be phase compared. The phase difference between the signals is determined by comparing the currents flowing through the rectifiers.

19. The evidence in the form of expert testimony and prior patents, 2,231,704 issued to Curtis and 2,281,995 issued to Purington, establishes that the method of phase comparison defined in claim 3 of the '350 patent, *i.e.*, the method of adding the signals to be phase compared, subtracting one of the signals from the other, separately rectifying the resulting signals, and comparing the direct potentials obtained from the step of rectification, merely describes the operation of phase discriminators which were known in the prior art. Claim 3 of the '350 patent is invalid under Title 35 U.S.C. § 103.

20. Plaintiff's exhibit M-1, consisting of pages from the Sperry Manual designated as "SPN 28," illustrates equipment procured by defendant for use in Loran-C systems. The defendant agreed that this exhibit is representative of equipment procured by the Government, and that the Government purchased at least one piece of equipment, which

also includes a receiving device responsive to the carrier frequency of the master station which is coupled to the slave oscillator. The receiving device operates to synchronize the slave oscillator with the oscillator at the master station. In this arrangement for synchronization, the slave oscillator is *sucked in*, *i.e.*, it operates in phase with the signals received from the master oscillator. The slave station also includes a phase adjuster in the pulse forming circuit to introduce a fixed time delay into the slave pulses relative to the received master pulses.

22. The receiver disclosed in the '980 patent includes a cathode ray oscilloscope for displaying the pulses received from the master and slave stations. The receiver is designed so that only one pulse may be displayed at a time. The pulse appears as a series of individual cycles of carrier frequency displayed on a spiral path on the oscilloscope. In measuring the time difference in arrival of master and slave pulses, the master pulse is first displayed on the oscilloscope and the third cycle of the pulse is visually aligned with a reference point on the spiral trace. Then the slave pulse is displayed on the spiral trace, and the distance along the spiral from the reference point to the third cycle of the slave pulse is measured to determine the time difference in arrival of the pulses.

23. Plaintiff's petition charged defendant with infringement of claims 1, 2, 3, 6, 8, and 9 of the '980 patent. Plaintiff later amended its petition to strike the allegations of infringement of claims 8 and 9. At trial, plaintiff presented evidence concerning the infringement of claim 7 of the '980 patent by defendant. Claim 1 of the '980 patent which is set forth in the opinion defines a radio navigation system which includes: (a) master and slave transmitters, (b) transmitting means at each station for radiating pulse

modulated carrier waves, (c) receiving means at the slave station responsive to the radiations from the master station, (d) a phase discriminator at the slave station, and (e) a phase regulator operated by the phase discriminator. Claim 2 differs from claim 1 by adding means for delaying the radiation of each pulse from said slave station a fractional part of said pulse separation period. Claim 3 differs from claim 1 by adding a mobile receiving apparatus including means for receiving the radiations from said stations, and time measuring means actuated by said receiving means for measuring the difference in time between the reception of pulses from each of said stations.

24. Patent claim 6 of '980 recites a radio frequency navigation system including a first stable crystal oscillator and a frequency dividing phase shaping circuit at the master transmitter station and a second stable crystal oscillator and phase shaping circuit at the slave transmitter station. Patent claim 7 of '980 recites a radio navigation aid in which the number of carrier wave cycles in each pulse is less than 100 and in which the time spacing between pulses is at least three times the duration of each pulse.

25. Defendant has contended that claims 1, 2, and 3 of the '980 patent are invalid under Title 35 U.S.C. § 102 in view of LF Loran, a navigation system which was developed after the Loran-A system. Specifically, defendant asserts that LF Loran anticipates the invention set forth in these claims under §§ 102(a), 102(b), and 102(g) of the patent statute. LF Loran is a hyperbolic electronic navigation system in which transmitting stations radiate pulse modulated carrier waves. The transmitting stations operate on a common carrier frequency of 180 kc. The LF Loran system employs one master station and two slave

stations. The pulse repetition rate of the signals from the master station is twice the repetition of the signals from the slave stations. In the operation of the system, the slave stations are locked to alternate pulses transmitted from the master station. In the LF Loran system, the pulses radiated from the master and slave stations are synchronized, and the carrier signals forming the master and slave pulses are also synchronized. The equipment of each slave station includes a crystal oscillator from which the carrier components and the pulse modulation of the slave pulses are derived. The crystal oscillator comprises an element of a timer used in the slave equipment to synchronize the transmitted slave signals with the master signals at the slave station. The timer includes an oscilloscope on which radio frequency signals corresponding to the carrier components of the master and slave pulses are displayed. The signals applied to the oscilloscope are derived from the slave oscillator and from a receiving antenna which responds to the master pulses. Synchronization of the slave station is accomplished by observing the signals on the oscilloscope and adjusting the phase and frequency of the slave oscillator so that the master and slave indications on the oscilloscope are superimposed. Thus, in the LF Loran system, slave synchronization is performed manually by an operator located at the slave station who observes an oscilloscope display and adjusts the slave equipment until the slave signal is brought into coincidence with the master signal.

26. Defendant has also contended that claims 1, 2, and 3 of the '980 patent are invalid under Title 35 U.S.C. § 103. In support of this defense, defendant has relied mainly on the Runge patent identified in finding 16, and on the British O'Brien patent, 579,170, dated July 25, 1946. Defendant

contends that the solution to the problem of maintaining two signals in a fixed phase relation, which is presented in the '980 patent, would have been obvious to a person having ordinary skill in the art in view of the Runge patent, the British O'Brien patent, and other prior art. This contention has merit. In addition, defendant contends that it would have been obvious to modify the LF Loran equipment in view of the disclosure of the Runge patent or the British O'Brien patent so that claims 1, 2, and 3 are invalid under § 103 of the patent statute. This contention is not reached.

27. Runge patent, 2,028,880, was a reference of record in the prosecution of the application for the '980 patent. It discloses, as noted in finding 18, an arrangement for synchronizing the carrier frequencies radiated from separate radio transmitters. The system of the Runge patent includes a master station and a slave station. A signal derived from the carrier frequency of the master station is applied to a phase comparison device at the slave station over a cable extending from the master station to the slave station. A signal derived from the carrier frequency of the slave station is also applied to the phase comparison device. The device measures the difference in phase between the two signals and provides an output which controls the phase of the carrier frequency generated at the slave station to synchronize that carrier frequency with the master carrier frequency.

28. British O'Brien patent, 579,170, discloses a phase controlling circuit in a radio transmitter of a navigation system. The circuit contains a phase discriminator for performing a phase comparison and a phase regulator controlled by the phase discriminator for changing the phase of a signal radiated from an antenna in response to the

phase difference detected by the phase discriminator. The effect of the phase controlling circuit is to prevent changes in the characteristics of the transmitting antenna from affecting the phase of the transmitted signal. The circuit compensates for any such changes and maintains the voltage applied to the antenna and the antenna current in a fixed phase relation. The British patent and the '980 phase discriminator-phase regulator operate in identical manner, to accomplish identical purposes.

29. Plaintiff presented evidence tending to establish a date of invention in the United States for the subject matter of the '980 patent prior to February 2, 1948, the filing date of the '980 patent application. The evidence related to a meeting between the inventor and his U.S. patent attorney in 1945, and to the attorney's subsequent return to the United States. This evidence was intended to establish a date of invention earlier than the dates on which the prior art references cited by the defendant were available, in order to avoid the issues of patent claim validity under §§ 102 and 103 of the statute. The plaintiff did not preserve this contention in its presentation to the judges.

30. R. L. Report 1061, defendant's exhibit 8, discloses the low frequency Loran system. Plaintiff and defendant agreed that Report 1061 constituted a publication on October 10, 1947, the date on which the LF Loran Report was placed on sale by the United States Department of Commerce.

31. The Loran-C system, described in findings 13 and 20, also includes transmitting equipment at the master and slave stations for generating pulses having the same carrier frequency, 100 kc. The pulses transmitted from the master and slave stations occur at the same repetition rate and have substantially the same time duration. The slave

station of the Loran-C system includes a receiving antenna responsive to the signals transmitted from the master station and from the antenna of the slave station. The signal received from the master station is used to synchronize signals from a local oscillator with the master carrier frequency. The signal from the local oscillator is applied through an adjustable phase shifter to a phase coherent detector. The received signal is also applied to said detector which makes a phase comparison of the two signals. The phase coherent detector controls a cycle resolver which in turn regulates the phase of the carrier-frequency-transmitted slave signal to maintain the transmitted master and slave carrier frequencies in a fixed phase relation. The phase detector also controls the adjustable phase shifter to synchronize the signals from the local oscillator with the received master carrier signals.

32. Defendant has contended that the '980 patent is a paper patent in that the system of that patent has never been commercially made by the plaintiff. It is unnecessary to reach this contention.

33. Defendant contends that claim 6 of the '980 patent is invalid because anticipated by the LF Loran system under Title 35 U.S.C. § 102. The LF Loran system is described in findings 25 and 30. Defendant further urges that this patent claim is invalid under Title 35 U.S.C. § 103 in view of United States Patent 2,067,353, issued to Snow in 1937. Snow patent, 2,067,353, discloses a radio transmitting system in which oscillators located at separate transmitting stations are synchronized with a frequency control source. The control source transmits a radio frequency signal which is received by antennas provided at each of the transmitting stations. The signals received by the antennas are applied to the respective oscillators in

order to synchronize the oscillator signals with the received frequency control signals. Patent claim 6 of '980 has not been infringed by defendant's Loran-C.

34. Defendant contends that claim 7 of the '980 patent is invalid under Title 35 U.S.C. § 102 because anticipated by the LF Loran system. In addition, defendant asserts that the patent claim is invalid under § 103 of that title in view of the United States patents issued to Runge, Snow, and O'Brien, identified in findings 16, 33, and 26, respectively. Claim 7 of '980 has not been infringed by Loran-C.

35. The '250 patent discloses a phase comparator circuit which is useful in phase controlled radio frequency navigation systems. The circuit operates to provide a direct potential which is a function of the phase angle between two radio frequency input signals applied to the circuit. It includes a pair of rectifiers to which the vector sum and vector difference, respectively, of the input signals are applied. A pair of resistances of equal magnitude are connected in series across the rectifiers to rectifier terminals of opposite polarity. By virtue of this arrangement, the potential which appears at the midpoint between the resistances is proportional to the cosine of the phase angle between the input signals.

Patent 2,568,250

36. In its petition, plaintiff alleged infringement of claims 1 and 2 of the '250 patent. At trial, plaintiff's evidence was directed to the question of infringement of claim 1. The only claim of the '250 patent which is here in issue is claim 1.

37. Claim 1 of the '250 patent, which is set forth in the opinion, defines a phase discriminator circuit for produc-

ing a direct potential having a magnitude which is proportional to the phase angle between first and second input signals. The claimed combination includes: (a) means for producing a third signal in phase opposition to one of the input signals; (b) a pair of rectifiers; (c) means for applying the vector sum of the first and second signals to one of the rectifiers; (d) means for applying the vector sum of the first and third signals to the other rectifiers; and (e) a pair of equal resistances connected in series across the rectifiers to rectifier terminals of opposite polarity to produce a direct potential at the midpoint between the resistances proportional to the cosine of the phase angle between the first and second input signals.

38. Defendant asserts that patent claim 1 of '250 is invalid under Title 35 U.S.C. § 102(b) in view of United States Patent No. 2,281,995 to Purington; that the claim is also invalid under Title 35 U.S.C. § 102(e) in view of United States Patent No. 2,603,748 to Bell; and that infringement of claim 1 by Loran-C has not been established.

39. Purington patent, 2,281,995, discloses a phase comparison circuit in which the vector sum and the vector difference of two input signals are separately applied to two rectifiers. The input signals are applied to the rectifiers through transformer windings which are arranged to provide the vector sum to one of the rectifiers and the vector difference to the other rectifier. The magnitudes of the rectified voltages across the rectifiers determine the magnitude of a direct potential which appears at the centerpoint of a resistor connected to rectifier terminals of opposite polarity through the transformer windings. The direct potential is applied to a phase meter which indicates the difference in phase between the input signals to the comparison circuit. The Purington patent was considered by

the Patent Office in the prosecution of claim 1 of the patent. Claim 1 was initially rejected by the Patent Office as unpatentable over the Purington patent. In the opinion of the patent examiner, the Purington reference disclosed a device having substantially the same structure and operating in the same way to produce the same result as the device defined in the patent claim. In response to the rejection, the patent applicant pointed out that the subject matter of the patent claim was not a broad invention and argued that the small differences between the claimed invention and the Purington patent provided the basis for a finding that the claimed invention was patentable. The applicant stressed that the Purington patent did not suggest the simplified arrangement of using a pair of equal series-connected resistances between rectifier terminals of opposite polarity. After this argument was presented, the Patent Office eventually allowed the patent claim 1.

40. Bell patent, 2,603,748, discloses a frequency detector which is employed to detect variations in the frequency of an input signal from a predetermined value. The operation of the detector is similar to the operation of a conventional phase discriminator circuit. The detector includes a pair of rectifiers and a pair of equal resistances connected in series between rectifier terminals of opposite polarity. In the operation of the detector, voltages representing the vector sum and vector difference of voltages derived from an input signal are applied to the rectifiers. The midpoint between the resistances provides a direct potential output. The Bell patent is not concerned with the problem of measuring the difference in phase between two input signals to the detector circuit. The direct potential derived from the circuit is not a function of the phase angle between two input signals. The Bell patent was not cited by the Patent

Office in the prosecution of the application for the '250 patent.

41. Plaintiff's evidence of patent infringement with respect to claim 1 of the '250 patent consists of a circuit diagram, plaintiff's Exhibit NN, representing equipment used in Loran-C, and testimony. Defendant stipulated that plaintiff's Exhibit NN represented equipment manufactured by the Sperry Company, at least one of which was procured by the Government for use in Loran-C. Loran-C does have circuit components which correspond to the language of the patent claim, but plaintiff's evidence concerning the operation of the Loran-C equipment was insufficient to warrant a finding that the operation thereof is substantially the same as the circuit operation set forth in claim 1 of the '250 patent. The evidence does not demonstrate that the Loran-C circuitry operates as a phase discriminator and produces a direct potential which represents the phase angle between two input signals which are compared. Claim 1 of the '250 patent has not been infringed by defendant's Loran-C.

Conclusion of Law

Upon the foregoing findings of fact which are made a part of the judgment herein, the court concludes as a matter of law that claims 1, 2, and 3 of patent 2,578,980 are invalid; that claims 6 and 7 of said patent have not been infringed; that claims 15-19 inclusive, of patent 2,598,290 have not been infringed; that claim 3 of patent 2,582,350 is invalid; that claim 1 of patent 2,568,250 has not been infringed; and that plaintiff is not entitled to recover. The petition is dismissed.

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In the Supreme Court of the United States

OCTOBER TERM, 1970

DECCA LIMITED, PETITIONER

v.

UNITED STATES

ON PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF CLAIMS

BRIEF FOR THE UNITED STATES IN OPPOSITION

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OCTOBER TERM, 1970

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DECCA LIMITED, PETITIONER

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BRIEF FOR THE UNITED STATES IN OPPOSITION

OPINION BELOW

The opinion of the Court of Claims (Pet. App. 79-141) is reported at 420 F. 2d 1010.

JURISDICTION

The judgment of the Court of Claims was entered on January 23, 1970 and a timely motion for rehearing was denied on April 17, 1970. The petition for a writ of certiorari was filed on July 16, 1970. The jurisdiction of this Court is invoked under 28 U.S.C. 1255(1).

STATUTE AND RULE INVOLVED

35 U.S.C. 103—Condition for patentability; non-obvious subject matter

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Rule 147(b), Rules of the United States Court of Claims

> (b) Commissioner's Report: The court may adopt the commissioner's report, including conclusions of fact and law, or may modify it, or reject it in whole or in part, or direct the commissioner to receive further evidence, or refer the case back to him with instructions. Due regard shall be given to the circumstance that the commissioner had the opportunity to evaluate the credibility of the witnesses; and the findings of fact made by the commissioner shall be presumed to be correct.

STATEMENT

Petitioner, the owner of United States Letters Patent No. 2,578,980,[1] which involves a system of elec-

[1] Hereinafter, the "'980" patent.

tronic aids to navigation, brought suit in the Court of Claims under 28 U.S.C. 1498 and 35 U.S.C. 281 for alleged infringement by the United States through the use of its "Loran-C" navigation systems. The Court of Claims, reversing the trial commissioner, held the '980 patent invalid on the ground that the differences between the invention and the prior art are obvious to one skilled in the art.

The '980 patent concerns electronic apparatus employing the principles of hyperbolic radio navigation, a highly technical subject that does not lend itself to succinct presentation. A detailed description of these principles and of the obviousness, from the prior art, of the invention claimed by petitioner is fully set forth in the Court of Claims opinion (Pet. App. 80-81, 88-89, 96-101).

ARGUMENT

1. In finding the '980 patent invalid, the Court of Claims properly applied the non-obviousness requirements of 35 U.S.C. 103. Radio signals may be transmitted either continuously or by "pulses." Petitioner's device synchronizes certain characteristics of pulses from transmitting stations. The two primary components used to accomplish this—the "sucked-in" oscillator and the phase-discriminator phase regulator—are part of the known art; the idea of pulse synchronization through the use of such an oscillator is old; and the use of a discriminator-regulator to control phase relationship for continuous waves (as distinguished from pulses) within transmitting stations was known through a British patent. By using a

modulator to convert pulses into waves and back again—a well-known process—both the "sucked-in" oscillator and the phase-discriminator phase-regulator can be employed in a pulse system, thus strengthening synchronization. Since this is essentially all the '980 patent does, the Court of Claims correctly concluded that "No component is new, and the whole combination, though it may have been new, was nevertheless obvious to one skilled in the art" (Pet. App. 105).

In so concluding, the court justifiably presumed that petitioner knew of all prior art in the area of hyperbolic radio navigational systems. It is well settled that an inventor is charged with such knowledge, see *Mast, Foos and Co.* v. *Stover Mfg. Co.*, 177 U.S. 485, 493, and this Court has recognized that the "knowledge stored in the Patent Office [is] readily available by the simple expedient of conducting a patent search—a prudent and nowadays common preliminary to well organized research." *Graham* v. *John Deere Co.*, 383 U.S. 1, 36. Further, the operating characteristics of the '980 patent in strengthening synchronization by means of combining pulses with continuous waves would not be "unexpected." See *United States* v. *Adams*, 383 U.S. 39, 51.

Petitioner, however, objects to the court's reference to the "colorful and useful guideline" of *In re Winslow*, 365 F. 2d 1017, 1020 (C.C.P.A.), (Pet. App. 104) and argues that this "presupposes the steps of *selection* and *juxtaposition* of [the] group of references" hanging on the fictional wall. (Pet. Br. 12).

But the court did not limit the prior art references to only a selected few, as petitioner asserts, but rather considered the inventor as having available "all prior art in the field" (Pet. App. 104). Of course, the inventor would have to make selections. But "obviousness" under Section 103 encompasses not only obviousness on its face, but also obviousness upon reflection and deliberation in light of prior art. In short, as the Court of Claims held, petitioner failed to satisfy "the demanding standard of invention explicated in . . . *Graham*," *Lear, Inc.* v. *Adkins*, 395 U.S. 653, 676.

2. Questions relating to this Court's standard for reviewing the Court of Claims' findings of fact are not properly presented, since petitioner has not shown that the result turns on the standard of review. Moreover, the highly technical subject matter of this case would make it a poor vehicle for resolving such questions, if there be any. Nor is there any reason for considering the standard by which the Court of Claims reviews the findings of its commissioners. The Court of Claims is not required to apply the "clearly erroneous" rule utilized by courts of appeals in reviewing the findings of district courts; its commissioners are not judges. See Rule 1, Fed. R. Civ. Pro. In any event, petitioner has not shown that under the "clearly erroneous" standard the result in this case would be different. Finally, the court's lengthy opinion (Pet. App. B) answers petitioner's contention that the court did not adequately explain its reasons for rejecting the commissioner's recommended findings.

CONCLUSION

It is respectfully submitted that the petition for a writ of certiorari should be denied.

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